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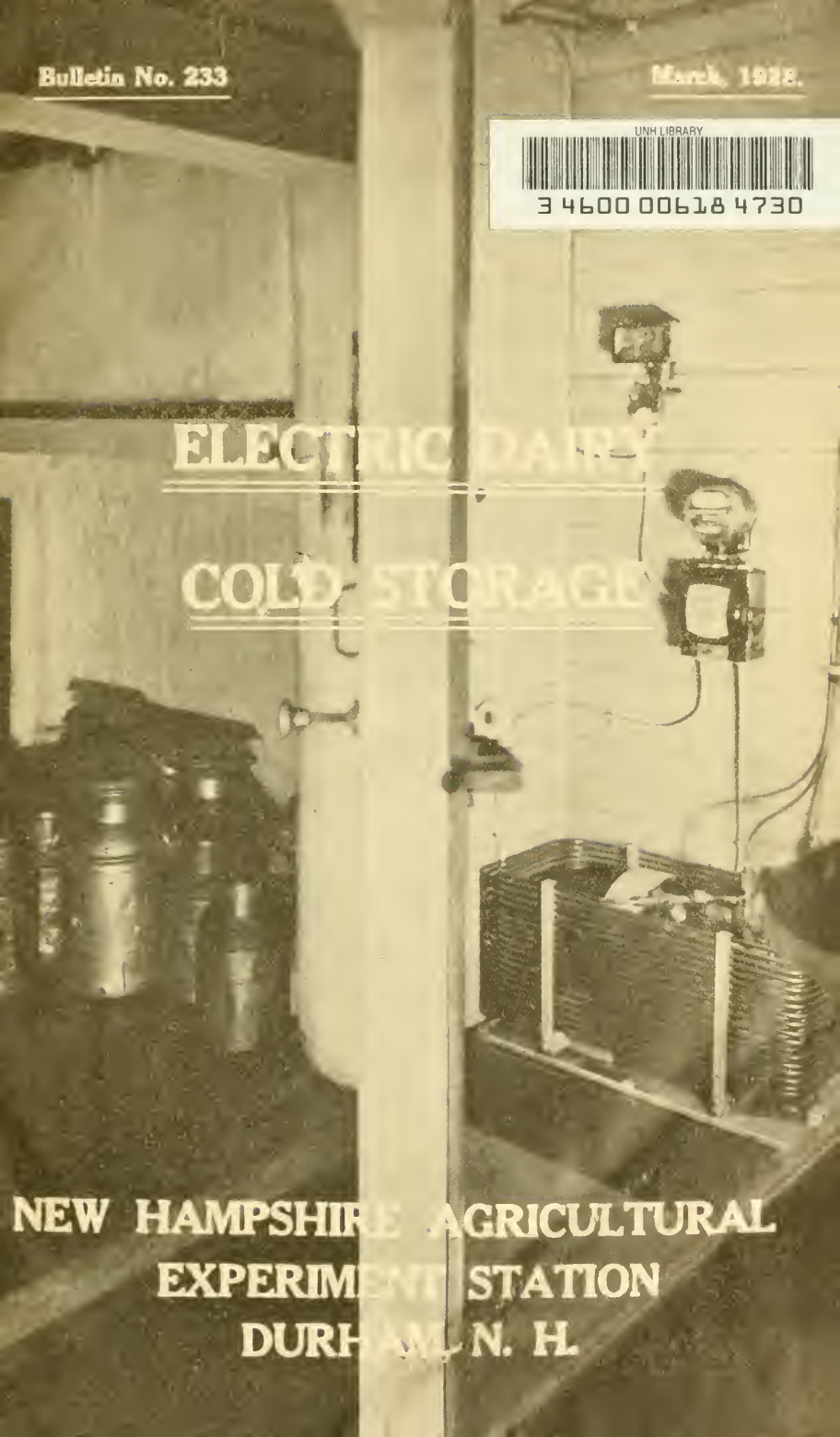

ELECTRIC DAIRY COLD STORAGE

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION
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The Energy and the Protein Content of Foods Regularly Eaten in a College Community

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The Energy and the Protein Content of Foods Regularly Eaten in a College Community

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INTRODUCTION

The present-day tendency in matters of diet is to stress the vitamines and minerals, and yet our main need for food is to secure energy, since energy or heat is just as necessary to run the human machine as it is to run any prime motor. The caloric value to the body of a food depends (1) upon the potential energy in the food as eaten, *i. e.*, upon its heat of combustion; (2) upon the energy leaving the body in the form of undigested matter in feces and urine; and (3) upon the energy used by the body in digesting and assimilating the food, *i. e.*, the "cost of digestion." Although the second and the third of these factors will vary somewhat according to the character of the food eaten, the second is relatively so constant with humans (about 8 per cent of the total potential energy) and the third is so small (on the average about 6 per cent) that they may be neglected in this discussion and we may concentrate our attention upon the first factor, the heat of combustion, considering this as representative of the food's caloric value.

To determine the heat of combustion has required, in the past, an expensive apparatus, manipulated with difficulty, the so-called "bomb calorimeter." The technique of this complicated machine, which gives extraordinarily accurate results, has been mastered by relatively few chemists and physicists. Calculation of the results also is usually a complicated procedure. Chemical analyses of the amounts of protein, fat, and carbohydrate in a food and calculation of the total heat of combustion from the known average heats of combustion of these three main nutrients are another means of determining the energy in food. But chemical analyses are even more time-consuming and costly than are direct determinations with the calorimetric bomb.

From comparisons of the heat of combustion of various foods, as directly determined by the bomb calorimeter, and the measured carbon-dioxide production during such combustion it is now known that the caloric value of a liter of carbon dioxide, although constant for any one group of nutrients, may vary with the different groups as much as 30 per cent (the extremes being 5.04 calories per liter with cane sugar and 6.64 calories with animal fat).[1] The relationship between the oxygen absorbed during a combustion and the heat liberated is, however, much closer, there being a maximum difference of but 6 per cent between the caloric value of a liter of oxygen absorbed in the combustion of cane sugar (5.04 calories) and that during the combustion of animal fat (4.72 calories). Since our food is a mix-

(1) The caloric value of protein is not considered in this comparison, since the protein metabolism plays but a relatively small role in the entire human metabolism.

ture of proteins, fats and carbohydrates, we could assume an average value of 4.825 calories for each liter of oxygen required in the combustion of a mixed food and compute the energy value of the food from the measured oxygen with an error of hardly plus or minus 3 per cent. Measurement of the carbon-dioxde production has been relatively simple, but until recently measurement of the volume of oxygen consumed has been accomplished only under the most difficult conditions. The progress in the development of respiration apparatus has, however, been such that today it is actually less difficult to measure the oxygen absorbed during a combustion than to measure the carbon dioxide produced. The simpler technique for determination of the heat of combustion of foods, therefore, requires at the present day not the use of the complicated bomb calorimeter, not the complex calculations from chemical analyses, but the direct measurement of the volume of oxygen consumed per gram of food substance burned, and the multiplication of this volume by the known caloric value of a liter of oxygen, according to the character of the substance burned.

PLAN OF RESEARCH

Based upon this simpler technique for the determination of the energy values of foods, a cooperative research[1] was undertaken by the Nutrition Laboratory of the Carnegie Institution of Washington, in Boston, Massachusetts, and by the New Hampshire Agricultural Experiment Station at Durham, New Hampshire. The object of this research has been to secure data regarding the energy and the protein content (1) of several individual foods, such as breads, pastry, soups, sandwiches, salads, desserts, ice creams, and candies; (2) of the total meal,—breakfast, dinner and supper; and (3) of the total food consumed per day by an individual.

The samples of food analyzed were for the most part secured either in Boston or in Durham. Three types of eating places are represented:—(1) the commercial restaurant where it is the custom to serve supposedly "standardized" meals for a fixed price, particularly at noon; (2) the college cafeteria where the meals are combinations of various portions or servings of food according to the choice of the individual; and (3) the drugstore where sandwiches and ice-cream mixtures may be obtained. At the college cafeteria no attempt was made to secure necessarily the most economical food combinations, but the basis of selection was the choice of the operator or the duplication of the choice of the individual immediately preceding the operator in line.

(1) During the first year of this research Miss Mary E. A. Pillsbury cooperated with us in making these food analyses. We wish to express here our deep appreciation of her able assistance.

A large number of calories are obtained each day by college students and by other individuals in "extra foods," such as candies and ice cream, taken apart from the regular meals.[1] Some of these foods are highly standardized, particularly the candies wrapped in packages and sold for five or ten cents. Because of the wide use of these extra foods, our study also included as comprehensive analyses of them as possible.

The foods analyzed are characteristic of those eaten by many individuals other than college students; for in American urban life the old-fashioned kitchen is being superseded by the modern kitchenette, the cafeteria, and the quick lunch, and the use of delicatessen and drug-store foods and the so-called "extra foods" is now widespread. The results of our research, therefore, although secured in essentially one locality, are believed to be representative of the energy values of many of the present-day, somewhat standardized foods, regardless of locality.

APPARATUS USED IN THIS RESEARCH

The apparatus which we have used for measurement of the oxygen consumption during food combustions is called the "oxy-calorimeter." It has already been described elsewhere in detail,[2] but inasmuch as it was first put to practical and extensive use in this particular research, we will give here a brief outline of its general principle and an account of such modifications in the technique as have seemed desirable since the publication of the detailed description.

The principle of the oxy-calorimeter is based upon the fact that dry organic material burns freely in an atmosphere of pure or nearly pure oxygen at ordinary atmospheric pressure, provided the chief product of combustion (carbon dioxide) is removed rapidly and the flame is fed with air relatively rich in oxygen. The oxy-calorimeter (See Fig. 1) consists of a small combustion chamber, A, a heat-resistant glass (pyrex) lamp chimney with its lower end in a water seal. A current of oxygen-rich air enters this combustion chamber at the top, leaves at the bottom, and passes through two bottles, B, B, containing soda-lime where the carbon dioxide produced by the combustion is completely absorbed. The air then enters a small rotary (suction) blower, C, from which it is discharged into the top of the chamber, thus making a complete circuit. A delicately counterpoised spirometer, D, is connected to the pipe leading from the blower to

(1) See Benedict, C. G., and F. G. Benedict, Boston Med. and Surg. Journ., 1918, **179**, p. 153; ibid., 1919, **181**, p. 415; ibid., 1921, **184**, p. 436.

(2) Benedict, F. G., and E. L. Fox, Indus. and Eng. Chem., 1925, **17**, p. 912; Benedict, F. G., and E. L. Fox, Journ. Biol. Chem., 1925, **66**, p. 783; Benedict, F. G., Abderhalden's Handb. d. biolog. Arbeitsmethoden. Abt. IV, Teil 13, 1929, p. 51.

the top of the lamp chimney. In the process of combustion there is considerable absorption of oxygen, and the air inside the circulating system of chimney, bottles and blower decreases in volume. This decrease is compensated by a discharge of oxygen from the spirometer into the main air current, and the ultimate effect is a fall in the level of the spirometer bell. This fall (read on a millimeter scale attached to the spirometer) serves as a measure of the volume of oxygen consumed.

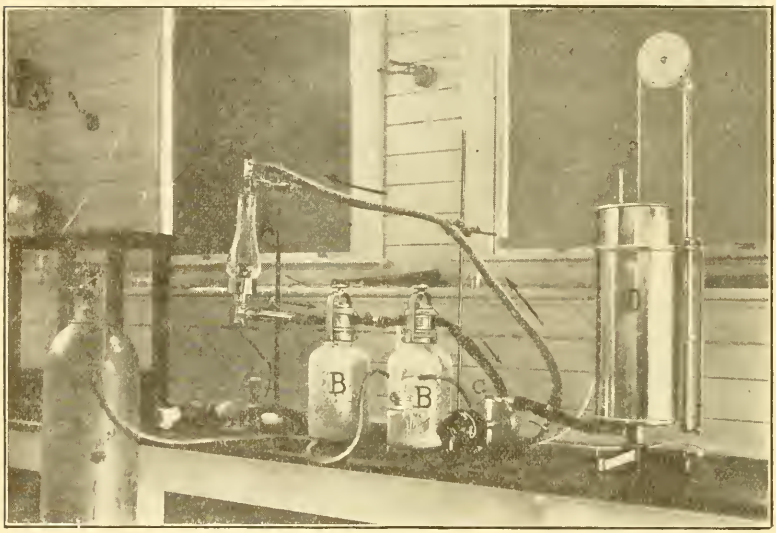

Fig. 1. The oxy-calorimeter for determining the energy values of foods and feces.

A, combustion chamber. B, soda-lime bottles for absorption of carbon dioxide. C, blower to circulate air current. D, spirometer to measure the volume of oxygen used.

The use of two soda-lime bottles permits complete exhaustion of the reagent in the first bottle. When this is exhausted, the second bottle (*i. e.*, nearest the blower) is substituted for the first; and another bottle, containing a fresh supply of soda-lime, is placed next to the blower. The small bottle shown in Fig. 1 directly in front of one of the soda-lime bottles serves as a safety trap during the introduction into the spirometer of oxygen from the cylinder of the compressed gas.

The actual combustion of a food sample in the oxy-calorimeter is carried out as follows:

A weighed amount of the food (approximately two grams), which has previously been brought to an air-dry condition (See page 11), is placed loosely in a small nickel crucible, and the crucible is placed inside the combustion chamber, supported by three small metal prongs in the base of the chamber. A fine iron wire is attached to two insulated, vertical posts either side of the crucible, and the central part of this wire rests upon the food sample. The glass lamp chimney is placed over the crucible, the apparatus is filled with oxygen, the motor is started, and the position and temperature of the spirometer bell are recorded. A current of electricity is passed through the iron wire, which is immediately raised to incandescence, and the food is ignited. Since the air in the combustion chamber is highly enriched with oxygen,[1] the combustion takes place rapidly and completely. At the end of the combustion, the lamp chimney is cooled with a damp cloth, and the final readings of the position and temperature of the spirometer bell are taken.

Standardization tests. The initial work with the oxy-calorimeter was controlled by direct combustions with a standardized bomb calorimeter. Pure organic substances, which burn readily, such as cane sugar, benzoic acid, and salicylic acid, were selected for this purpose. The volume of oxygen required in the combustion of a gram of each of these substances was determined with the oxy-calorimeter, and the actual amount of heat liberated per gram was found with the bomb calorimeter. Thus the caloric value of oxygen (that is, the calories per liter of oxygen required to burn the substance) was directly established and found to agree with theory. In addition to these initial tests, the accuracy of the instrument was frequently controlled during its use in this particular research by burning in it a substance of known chemical composition, such as pure sugar. From the chemical equation $C_{12}H_{22}O_{11}+12\ O_2 = 12\ CO_2+11\ H_2O$ it can be computed that each gram of cane sugar requires in its combustion 785.5 c. c. of oxygen at standard conditions of temperature and pressure. In a series of combustions of cane sugar made with the oxy-calorimeter at the beginning of this research it was found that the apparatus recorded on the average a consumption of 776.8 c. c. of oxygen per gram of cane sugar or 98.88 per cent of theory.[2] The results of other combustions of cane sugar made during the progress of the research, corrected by this amount, have shown astonishingly close agreement with the theoretical value. An additive correction of 1.12 per cent was, therefore, made in all the values for heats of combustion obtained with this apparatus.

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(1) The oxygen which we have used in this apparatus is that commonly furnished in cylinders for ordinary acetylene welding or cutting of steel by modern methods.

(2) See note 2, page 12.

Nitrogen determinations. During the combustion of nitrogenous substances there is a liberation of pure nitrogen. This nitrogen accumulates in the closed system and obviously affects the apparent decrease in volume of the oxygen in the spirometer, since each cubic centimeter of nitrogen liberated takes the place of a cubic centimeter of oxygen which would otherwise pass from the spirometer into the air current. Thus the apparent contraction in volume due to the absorption of oxygen is too low and a correction is necessary. This correction is arrived at by determining the nitrogen in the substance to be burned. It is usually desirable to know the protein content of a food as well as the caloric value. Hence total nitrogen determinations by the Kjeldahl method have been included in our assessment of food values. These determinations not only indicate the amount of protein in the food but make it possible to correct the oxygen measurement obtained with the oxy-calorimeter. Pure nitrogenous substances, such as urea, hippuric acid and uric acid, were burned in the oxy-calorimeter, and the accuracy of the correction for nitrogen was thoroughly established.

Adaptability and accuracy of the apparatus. The adaptability of the oxy-calorimeter for studying problems in nutrition, especially with humans, is evidenced by the fact that the combustion chamber can be applied to almost all of the respiration apparatus used at the present day for determining basal metabolism. Tests made at the Nutrition Laboratory with practically all of the various types of respiration apparatus show that the combustion chamber is as well adapted to any of them as to the particular type used in our experiments.

With the ordinary food mixtures eaten by man and animals, and particularly with excreta, the difficulty of securing a truly characteristic sample is so great that the accuracy of the oxy-calorimeter is far inside of any possible limit of accuracy which could be expected in the sampling. Indeed, the oxy-calorimeter has been recommended for determining the energy value of industrial fuels, coals, and fuel oil,[1] which for economic reasons require extremely close determinations.

PREPARATION OF SAMPLE FOR COMBUSTION

Practically all of the foods eaten by man are too moist to burn readily without previous preparation. All foods except candies, dry cereals, crackers and the like must, therefore, be dried until they contain not more than 20 per cent and usually nearer 10 per cent of moisture. For this purpose the fresh food is accurately weighed in

(1) Benedict, F. G., and E. L. Fox, Indus. and Eng. Chem., 1925, 17, p. 912.

a previously weighed dish or pan.[1] The pan and contents are then placed either in an ordinary "air-bath" or in an electrically heated oven. It so happened that throughout most of this research an electric oven was used having four heating units, which made it possible to adjust the temperature at from 50° to 80° or 90° C. The many shelves in the oven permitted changing positions of the dishes, so that the samples were dried rapidly and in sequence. The drying usually requires from 24 to 96 hours, depending upon the water content and, to a certain extent, upon the fat content of the sample. Frequent stirring, especially of watery and fatty food, either with a glass rod (weighed with the pan) or with a knife which can be scraped clean upon the side of the pan, is necessary, since the top of the sample sometimes dries and forms a hard crust, while the bottom remains moist and is apt to mold, unless thoroughly dried.

When the sample has reached a seeming dryness, the pan is taken from the oven, placed on a shelf in the laboratory, and left for a day or two so that the dried and thoroughly stirred sample may adjust itself to the humidity of the air. The pan with its contents is then weighed again, and the difference between this weight and the initial weight of the empty pan represents the *air-dry* weight of the substance. The sample is now dry enough to burn, but may need to be put, first, through a grinder or chopping machine. Two or two and one-half grams of the air-dry, ground substance are weighed into each crucible, ready for combustion. This amount permits good sampling without too great comminution.

Samples of salads which cannot be made homogeneous by mixing, because of the large amount of oil in the mayonnaise, may be dried with known weights of bread or cracker meal of known caloric value, or a small amount of powdered pumice stone may be added to the sample. Powdered pumice stone may also be mixed with or spread on top of carbohydrates before burning, to keep them from frothing over the edge of the crucible, but this, we find, is not necessary with small samples of cane sugar. During the burning of some substances, such as salads, sandwiches, or doughnuts, soot will be deposited on the chimney or unburned carbon will be left in the crucible, if the combustion is not regulated. Pumice stone mixed with the sample after weighing will retard the combustion so that the flame does not touch the chimney, but the oil or fat is apt to soak through the pumice stone to the bottom of the crucible and not burn. To avoid this, the food sample and the pumice stone may be mixed with a glass stirring rod and the mixture allowed to remain in a lump

(1) In the case of the meals including more than one food, the servings were added one at a time to the pan and the pan and contents weighed after each addition, each gain in weight representing the fresh weight of the particular item added to the pan.

around the rod, standing up in the center of the crucible. This makes it possible for the oxygen-rich air to come in contact with all of the sample. More satisfactory and consistent results can be obtained by regulating the rate of circulation in the closed system of the oxy-calorimeter with an external resistance governing the speed of the motor.

Feces were not analyzed in this research. The feces of both humans and animals were, however, studied in the original development of the apparatus[1] and require no different preparation for combustion from that described here for foods.

CALCULATION OF RESULTS

The volume of oxygen (reduced to O° C., dry, and 760 mm. pressure) consumed in the combustion of one gram of an air-dry food is calculated by the formula:

$$V = \frac{L \times K \times F \times M}{W}$$

in which V is the reduced volume of oxygen per gram of air-dry matter, expressed in cubic centimeters; W is the air-dry weight of the substance in grams; L is the change in level of the spirometer bell, expressed in millimeters; K is the apparent volume of the bell in cubic centimeters per millimeter of its length (in our particular apparatus 20.80 c. c.); F is the constant correction factor[2] 1.0112 which was obtained by the standardization tests with cane sugar (see page 9); and M is the factor for reduction of the apparent volume to standard conditions of O° C., dry, and 760 mm. pressure. This last factor, M, is based upon the prevailing barometric pressure and the average temperature of the spirometer. The value of M is found by reference to the standard tables published by Carpenter,[3] the air in the apparatus being considered completely saturated.

The analysis of a chicken sandwich may be used as a typical illustration of the method of calculation. When 2.55 grams of the air-dry material were burned, it was found that L, the change in level of the spirometer bell, was 149 mm. Since the average temperature of the spirometer was 25.8° C. and the barometric pressure was 762 mm., the value of M is 0.886. The formula then becomes

(1) Benedict, F. G., and E. L. Fox, Indus. and Eng. Chem., 1925, 17, p. 912; ibid., Journ. Biol. Chem., 1925, 66, p. 783.

(2) In the initial work with the oxy-calorimeter, corrections were made for the 5 c. c. of oxygen required for the ignition of the iron wire and for the slight rise in temperature of the spirometer. These corrections are eliminated by the use of the factor F.

(3) Carpenter, T. M., Carnegie Inst. Wash. Pub. No. 303A, 1924, tables 7 and 8, pp. 39 to 70. The barometric pressure in millimeters, as recorded across the top of these tables, represents the barometric reading corrected for brass scale reading only and not for tension of aqueous vapor. The correction for tension of aqueous vapor is taken care of in the logarithms given in the body of the tables.

$$V = \frac{149 \times 20.80 \times 1.0112 \times 0.886}{2.55} = 1089 \text{ c. c. } O_2$$

Another analysis gave a value of 1097 c. c. of oxygen, the average reduced volume therefore being 1093 c. c.

This reduced volume of oxygen consumed per gram of air-dry sandwich burned must be corrected for the amount of nitrogen liberated per gram of air-dry sandwich during the combustion. The Kjeldahl analyses indicated that the air-dry sandwich contained on the average 2.52 per cent of nitrogen. Since one milligram of nitrogen occupies 0.8 c. c. under standard conditions of temperature and pressure, the total volume of nitrogen liberated in the combustion of one gram of air-dry chicken sandwich was 20 c. c. Therefore, the average reduced volume of oxygen per gram of air-dry substance, 1093 c. c., should be increased by 20 c. c., and the total is thus 1113 c. c. or 1.113 liters. Multiplication of this value by 4.825,[1] the caloric value of a liter of oxygen when mixed foods are burned, gives 5.4 calories per gram of air-dry matter. Since the air-dry weight of the total sandwich was 37 grams, the total energy content of the sandwich is 200 calories and the total protein content (assuming one gram of nitrogen equals 6.25 grams of protein) is 5.8 grams.

DISCUSSION OF RESULTS

Tabulation of data. The actual determinations made were the fresh weight, the air-dry weight, the nitrogen content, and the oxygen required during the combustion of the air-dry food. The results of these determinations are summarized in the following tables, including calculations of the total energy and the total protein in the food per serving or per unit as sold, and the calories per gram of air-dry matter. In addition, in order to study the economic value of the different foods, the cost of each food unit and the calories and protein which may be purchased for 10 cents are also given in most instances. The prices listed are those current during 1927 and 1928. Numbers were assigned to the food samples in the chronological order in which they were analyzed. Thus, the time intervening between the analysis of sample No. 1 and the last sample, No. 477, is two years; and the time elapsing between repeated analyses of the same kind of food is, therefore, roughly indicated by the sample numbers.

BREADS AND MUFFINS

Since innumerable analyses of the various kinds of bread have already been made, our study of this type of food was limited to analyses of individual slices or single rolls or muffins, with the object

(1) In the case of samples which were decidedly greasy the factor 4.7 has been used.

TABLE 1. *Breads and Muffins.*

No.	Name of food	Serving*	Cost of serving	Place where purchased	Weight of one portion†		Protein		Calories		
					Fresh	Air-dry	Total per portion	For‡ 10c	Total per portion	Per gm. air-dry matter	For‡ 10c
			cts		gm.	gm.	gm.	gm.			
58	Bread, white	2 slices & butter	5	A	35	25	3.5	14.2	106	4.2	625
74	Bread, white		..	K	28	22	2.3	...	94	4.3	...
84	Bread, white	2 slices & butter	10	B	14	10	1.4	2.9	41	4.0	140
143	Bread, white	Loaf, 16 slices	12	M	33	23	2.8	...	94	4.1	...
293	Bread, white	3 slices & butter	10	D	16	11	1.5	4.6	45	4.1	210
57	Bread, graham	2 slices & butter	5	A	39	29	3.9	15.8	119	4.1	675
130	Bread, raisin	3 half slices & butter	5	A	42	33	4.2	12.8	126	3.8	580
	Minimum		..	..	*14*	*10*	*1.4*	...	*41*	*3.8*	...
	Maximum		..	..	*42*	*33*	*4.2*	...	*126*	*4.3*	...
	AVERAGE		..	..	..	..	...	...	...	**4.1**	...
96	Bread, corn	2 pieces & butter	5	A	51	35	3.0	12.2	163	4.7	850
34	Muffins, cornmeal	2 & butter	5	A	59	46	3.9	15.8	218	4.7	1070
68	Muffins, cornmeal	2 & butter	5	A	61	46	3.6	14.6	211	4.6	1045
69	Muffins, cornmeal	2 & butter	10	D	66	52	4.0	8.1	231	4.5	535
35	Muffins, graham	3 & butter	10	C	42	30	2.7	8.2	143	4.8	485
70	Muffins, graham	3 & butter	10	C	29	24	2.2	6.7	117	4.9	405
72	Muffins, graham	2 & butter	5	A	54	40	4.6	18.6	189	4.7	955
78	Muffins, graham	3 & butter	10	C	35	28	2.4	7.3	126	4.5	435
82	Muffins, rice	3 & butter	10	B	51	39	3.0	9.1	190	4.9	630
67	Muffins, white	3 & butter	10	B	46	34	3.0	9.1	164	4.8	550
87	Muffins, white	2 & butter	10	D	47	37	3.0	6.1	173	4.7	420
145	Muffins, white	2 & butter	10	D	60	44	3.9	7.9	203	4.6	480
146	Muffins, blueberry	2 & butter	10	C	42	30	2.5	5.1	138	4.5	330
	Minimum		..	..	*29*	*24*	*2.2*	..	*117*	*4.5*	...
	Maximum		..	..	*66*	*52*	*4.6*	...	*231*	*4.9*	...
	AVERAGE		..	..	..	..	...	...	....	**4.7**	...

17	Rolls, white	Seven§	8	E	43	31	3.5	30.6	118	3.8	1035
29	Rolls, white	2 & butter	10	B	41	29	3.3	6.7	125	4.3	310
33	Rolls, white	2 & butter	5	A	44	31	4.3	17.4	125	4.1	700
73	Rolls, white	2 & butter	5	A	37	25	3.4	13.8	99	4.0	595
75	Rolls, white	2 & butter	10	B	39	29	3.5	7.1	120	4.2	300
71	Rolls, sweet	2 & butter	5	A	41	31	3.6	14.6	134	4.4	735
36	Rolls, graham	2 & butter	5	A	46	30	4.1	16.6	128	4.2	710
	Minimum		..	..	*37*	*25*	*3.3*	...	*99*	*3.8*	...
	Maximum		.	..	*46*	*31*	*4.3*	...	*134*	*4.4*	...
	AVERAGE		..	..	..	..	...	...	....	**4.1**	...
66	Toast, buttered	4 slices	10	B	19	16	1.8	7.2	81	5.2	324
76	Toast, buttered	3 slices	10	C	26	22	2.3	6.9	109	4.9	327
79	Toast, buttered	3 slices	10	F	17	16	1.6	4.8	77	4.7	231
105	Toast, buttered	4 slices	10	D	22	19	2.1	8.4	94	4.9	376
	Minimum		..	..	*17*	*16*	*1.6*	...	*77*	*4.7*	...
	Maximum		..	..	*26*	*22*	*2.3*	...	*109*	*5.2*	...
	AVERAGE		..	..	..	..	...	...	....	**4.9**	...
77	Toast, not buttered	2 slices & butter	5	A	21	20	1.8	7.4	79	4.1	515

* The butter given with the serving was not included in the analysis except in the cases of buttered toast.

† A portion means one slice of bread or toast, one muffin, or one roll. In each instance, however, more than one portion was included in the sample for analysis, and the values given are therefore average values per portion.

‡ The food values of an average serving of butter from each restaurant have been included. (See Table 16.)

§ Purchased in a store and not served in this amount to be eaten by one person.

of determining how many calories are furnished per portion as ordinarily served. The data are given in Table 1. The butter served with the bread was not included in the sample analyzed, except in the case of the buttered toast. With this exception, therefore, the values given in the table for the total energy and the total protein content represent the bread or muffins alone, without the butter. In calculating the calories and the protein for ten cents, however, assumptions have been made for the food value of the butter, based upon the average servings of butter given at the various places where food samples were purchased. (See Table 16, page 38.) Because of the assumptions made for the butter, the calories for ten cents are recorded only to the nearest 5 calories.

The energy content per gram of air-dry matter averages 4.1 calories with the sliced bread, the rolls, and the unbuttered toast, a value identical with the average caloric value of pure carbohydrates. The average factors for the muffins and the buttered toast are somewhat greater, 4.7 and 4.9 calories, respectively, indicating the presence of more fat.

Since some of the restaurants charged five and some ten cents for an order of bread (or muffins) and butter, the calories for ten cents vary from 140 (sample 84, sliced bread) to 1070 (sample 34, cornmeal muffin). In most instances, however, at least 400 or 500 calories may be secured in this form for ten cents. The protein for ten cents likewise has a wide range, from 2.9 to 30.6 gm., amounting in general to at least 7 or 8 gm.

DOUGHNUTS, COOKIES AND CAKES

The data for doughnuts, cookies, and cakes are given in Table 2. The plain doughnuts average 38 grams (fresh weight) and have an average total energy value of 172 calories each. The calories per gram of air-dry matter are notably high, 5.6 on the average, owing to the fat in the doughnut. The results for the chocolate doughnut are much the same. More variation is shown with the fried cakes. In general, doughnuts and fried cakes contain about 180 or 200 calories per piece and approximately 2 grams of protein. The caloric value per gram of air-dry matter with the cookies and the cup cakes indidicate that they contain a minimum amount of fat. The energy value for 10 cents of these sweetened breads averages nearly 700 calories, or more than twice as much as that of buttered toast and more than that of most of the orders of muffins. The protein for ten cents ranges from 4.2 to 11.5 gm., a smaller range than noted with the bread and muffins.

TABLE 2. *Doughnuts, Cookies, and Cup Cakes.*

No.	Name of food	Cost	Place where bought	Weight of portion*		Protein		Calories		
				Fresh	Air-dry	Total per portion	For 10c	Total per portion	Per gm. air-dry matter	For 10c
				gm.	gm.	gm.	gm.			
1	Doughnut	25c dozen	E	39	32	1.9	9.1	176	5.5	704
85	Doughnut	15c half dozen	S	44	36	2.1	8.4	196	5.4	784
86	Doughnut	13c half dozen	D	33	29	1.7	7.9	155	5.4	715
116	Doughnut	3 for 10c	H	41	32	2.9	8.7	177	5.6	531
351	Doughnut	25c dozen	W	36	31	1.9	9.1	178	5.8	855
255	Doughnut	13c half dozen	X	34	27	1.8	8.3	151	5.6	697
264	Doughnut, chocolate	3 for 10c	F	32	28	1.4	4.2	164	5.8	492
91	Doughnut, chocolate	3 for 10c	F	34	31	2.2	6.6	170	5.5	510
142	Doughnut, chocolate	13c half dozen	M	41	33	2.1	9.7	177	5.3	817
92	Fried cake†	3 for 10c	F	39	34	1.8	5.4	174	5.1	522
141	Fried cake	13c half dozen	M	44	37	1.9	8.8	227	6.1	1048
256	Fried cake	13c half dozen	X	46	39	2.5	11.5	210	5.4	969
287	Fried cake	13c half dozen	W	39	32	1.7	7.8	176	5.4	812
	Minimum			*32*	*27*	*1.4*	*4.2*	*151*	*5.1*	*492*
	Maximum			*46*	*39*	*2.9*	*11.5*	*227*	*6.1*	*1048*
	AVERAGE								**5.5**	
435	Cookies, hermit	2 for 5c	B	45	43	2.2	8.8	207	4.8	828
117	Cookies, oatmeal	2c each	M	30	30	1.6	8.0	140	4.7	700
2	Cookies, sugar	15c dozen	E	11	15	1.0	8.0	73	5.0	584
102	Cup cakes, spiced	5c each	F	57	45	2.5	5.0	210	4.7	420
3	Cup cakes, sugar	30c dozen	E	42	35	1.9	7.6	148	4.2	592
4	Cup cakes, molasses	30c dozen	E	54	42	2.4	9.6	189	4.5	756
299	Cup cakes, chocolate	5c each	F	44	38	2.2	4.4	190	5.0	380

* A portion means one doughnut, cookie, or cake. In each instance, however, more than one portion was included in the sample for analysis, and the values given are therefore average values per portion.

† Round, much like a doughnut, but thicker, fried and rolled in powdered sugar.

TABLE 3. *Sandwiches.*

No.	Name of sandwich*	Description of filling	Place where purchased	Weight of sandwich		Protein	Calories	
				Fresh	Air-dry	Total per sandwich	Total per sandwich	Per gm. air-dry matter
				gm.	gm.	gm.		
297	Bacon	Strips of fried bacon to cover one slice of bread; small amount of mayonnaise	O	48	37	5.2	209	5.6
416	Cheese, pimento	Average 23 gm. cheese	P	63	44	8.6	222	5.0
267	Cheese and jelly	½ to 1 tbsp. cheese spread on one slice of bread; jelly on other slice	O	68	43	3.9	203	4.7
269	Cheese and nut	Ca. 1 tbsp. cream cheese, chopped walnuts and orange marmalade	F	64	45	5.1	226	5.1
46	Cheese and olive	Cream cheese, chopped olives	F	50	32	3.7	155	4.8
56	Cheese and olive	Cream cheese, chopped olives, some butter	O	68	41	5.5	209	5.1
42	Chicken	Chopped chicken, mayonnaise	F	55	37	5.9	200	5.4
376	Chicken salad	Lettuce, ca. 1 tbsp. chopped chicken and celery, mixed with plenty of mayonnaise	F	72	41	7.0	199	4.8
100	Cucumber	Lettuce, little butter, cucumber, generous amount of mayonnaise	O	65	32	3.5	162	5.0
104	Cucumber	Sliced cucumber, mayonnaise	F	74	40	4.2	205	5.1
54	Egg	Chopped egg, mayonnaise, a little butter	O	59	35	4.9	188	5.4
270	Egg	Ca. 2 tbsp. chopped egg and pimento mixed with mayonnaise	F	78	43	6.8	217	5.1
298	Egg & asparagus	Ca. 1 tbsp. chopped egg and mayonnaise; 3 stalks of canned asparagus	O	69	34	5.5	173	5.1
268	Egg & pimento	Ca. 1 tbsp. chopped egg and pimento mixed with mayonnaise	O	60	34	5.7	174	5.1
53	Ham	Sliced ham, butter	O	53	35	7.1	174	5.0
323	Ham, sliced	Sliced ham, ¼ inch thick	P	69	47	10.2	234	5.0
355	Ham, sliced, toasted	Sliced ham, ⅛ inch thick; sandwich greased and toasted	L	68	45	9.2	216	4.8
340	Ham, sliced, toasted	Sliced ham, ¼ inch thick; sandwich greased and toasted	G	82	57	11.5	300	5.3
43	Ham and egg	Mixture of ham, egg, pickle, all chopped, mixed with mayonnaise	F	64	40	6.8	201	5.0
262	Ham, special	Filling of chopped ham, egg, piccalilli and pimento; probably mayonnaise	F	80	49	8.6	234	4.8
44	Lettuce	Iceberg lettuce, mayonnaise	F	66	39	3.5	214	5.5
55	Lettuce	Lettuce, mayonnaise, butter	O	71	56	4.9	327	5.8
45	Peanut butter	Peanut butter	F	59	48	9.7	269	5.6
263	Peanut butter	Ca. 2 2/3 tbsp. peanut butter	F	85	75	18.0	444	6.0
417	Peanut butter, toasted	Thin layer peanut butter; sandwich greased and toasted	L	59	50	7.7	255	5.1
99	Tomato	Tomato, lettuce, mayonnaise	F	78	40	4.2	204	5.1
101	Tomato	Tomato, lettuce, mayonnaise	O	83	40	4.2	200	5.0
377	Tomato	Lettuce, 2 slices of tomato, generous amount of mayonnaise	F	77	45	4.2	220	4.9
375	Tomato salad	Lettuce, 2 slices of tomato, mayonnaise	O	93	38	4.6	180	4.7
374	Tuna salad	Lettuce, tuna fish, mixed with mayonnaise	O	83	48	9.2	239	5.0
	Minimum		..	*48*	*32*	*3.5*	*155*	*4.7*
	Maximum		..	*93*	*75*	*18.0*	*444*	*6.0*
	AVERAGE		..	..	..	....	....	**5.1**

SANDWICHES

A general survey of sandwiches is given in Table 3. The caloric value per gram of air-dry material is relatively high, in practically all cases 5 or over and in one instance 6. Proximate analyses were not made, hence the proportion of fat is not known. But the fact that the highest heat of combustion per gram of air-dry material was found in a peanut-butter sandwich instantly suggests that the large proportion of oil in the sandwich must have accounted for this value. The protein content varies considerably, the highest being found in the peanut-butter, ham, and tuna salad sandwiches. The average value is not far from 5 to 6 grams in the other sandwiches. In general one obtains in the ordinary sandwich about 200 calories and from 5 to 10 gm. of protein for 10 cents. The differences in the duplicate sandwiches purchased at different places show that the sandwich is only approximately standardized.

PACKAGE SANDWICHES AND COOKIES

In recent years manufacturers have sold in small packages, usually at 5 cents per package, so-called "sandwiches," which consist of two crackers with various fillings. These vary in size, weight and composition with the different manufacturers, and the calories per gram of air-dry matter differ according to the fat content, as seen in Table 4. On the average one of these 5-cent packages contains nearly 200 calories, or as much energy as is contained in the average 10-cent sandwich.

SALADS

In our study of salads two procedures were followed. At the college cafeteria (A) it is the practice to serve salads without bread or butter, an extra charge being made for these food items. Our samples obtained at this cafeteria were therefore analyzed without rolls and butter, and the results of each analysis are for the salad alone. These data are given in Table 5. Included in this table likewise are the analyses of three salads obtained from Restaurant B, which were analyzed without the rolls and butter (although these were a part of the serving), and an analysis of a salad purchased at Restaurant Y.

Restaurants B, C and D in this college community are accustomed to include bread or rolls and butter in their servings of salad,—bread at noon and rolls at night. A number of salads from these restaurants were analyzed, each analysis including the bread or rolls but not the butter. The results are recorded in Table 6, the values for the salad and rolls being based upon actual combustions and those for

TABLE 4. *Package Sandwiches and Cookies.*

No.	Name of sandwich	Description	Weight of package*		Protein	Calories	
			Fresh	Air-dry	Total per package	Total per package	Per gm. air-dry matter
			gm.	gm.	gm.		
344	Fig newtons	4 cookies with fig jam filling	50	49	2.0	206	4.2
80	Jus-t-nuf	4 sandwiches, each of 2 crackers and peanut butter filling	46	46	7.5	252	5.5
386	Kake-O-Figs	4 cookies with fig jam filling	58	56	2.2	211	3.8
238	Manhattan	3 sandwiches, each of 2 graham crackers with cream filling	50	50	2.1	252	5.1
265	Mighty Good	3 sandwiches, each of 2 crackers made with cheese and spread with peanut butter	28	29	5.8	160	5.6
81	Mighty Good	3 sandwiches, each of 2 crackers made with cheese and spread with peanut butter	28	28	5.4	154	5.5
97	Oreo	4 sandwiches, each of 2 chocolate wafers with cream filling	43	43	2.5	211	4.9
345	Peanut butter cheese	4 sandwiches, each of 2 crackers baked with cheese, and spread with peanut butter	33	33	6.3	183	5.5
341	Peanut butter patties	2 pieces marked in 3 sections each; nabisco made with peanut butter	35	35	4.0	193	5.6
98	Sunshine	4 sandwiches, each of 2 crackers spread with peanut butter	31	31	4.0	149	4.8
342	Triton	3 sandwiches, each of 2 cookies with cream filling	39	38	1.7	189	5.0
343	Tutti-Frutti Wafer	One wafer made of layers of nabiscoes and fruit jam	28	28	1.0	115	4.2

* Each package cost 5 cents.

TABLE 5. *Salads (analyzed without rolls and butter).*

No.	Name and cost as served	Description of salad as served	Restaurant where bought	Weight of salad		Protein	Calories in salad		
				Fresh	Air-dry	Total in salad	Total	Per gm. air-dry matter	For 10c
				gm.	gm.	gm.			
52	Asparagus (20c) ...	Asparagus tips, lettuce, mayonnaise	A	112	25	3.8	169	6.7	85
13	Banana & nut (40c).	With cream dressing	Y	191	50	2.7	289	5.7	§
51	Egg (20c)	Sliced, hard-boiled egg, lettuce, mayonnaise	A	143	48	11.6	358	7.5†	179
50	Fruit (20c)	Pineapple, pear, peach, apricot, lettuce, mayonnaise.	A	276	81	1.2	350	4.3	175
65	Fruit (35c)	Orange, grape fruit, apple, pineapple, lettuce, boiled dressing‡, rolls and butter	B	368	65	4.3	259	4.0	104*
83	Fruit (20c)	Pineapple, pear, peach, apricot, lettuce, mayonnaise	A	235	65	1.0	258	4.0	129
63	Pineapple and cream cheese (35c)	2 slices pineapple, 2 cubes cream cheese, chopped nuts, lettuce, boiled dressing‡, rolls and butter ...	B	222	59	4.2	276	4.7	110*
94	Sardine (20c)	Sardines, slice of lemon, lettuce	A	69	28	12.0	175	6.3	88
37	Tuna fish (25c)	Tuna fish, celery, olives, lettuce, mayonnaise	A	192	84	30.9	566	6.8†	226
61	Vegetable (20c)	String beans, peas, beets, lettuce, mayonnaise	A	260	64	5.6	385	6.0	193
64	Vegetable (35c)	Peas, string beans, beets, potato, lettuce, boiled dressing‡, rolls and butter	B	392	54	9.4	229	4.2	92*

* Allowance of 10 cents made for cost of rolls and butter in calculating calories for 10 cents in salad alone.

† Sample 51 mixed with crumbs and sample 37 with cracker meal before being burned because so oily; the caloric value per gram of air-dry matter as actually burned (i. e., including crumbs or cracker meal) was 6.3 and 6.4 calories, respectively; values in table have been corrected for energy and protein content of crumbs and cracker meal.

‡ Contained no oil.

§ Cannot be computed; possibility that rolls and pat of butter may have been included in price of salad.

No.	Name and cost as served	Description of salad as served	Restaurant where purchased	Sample analyzed	Weight		Protein	Calories		
					Fresh	Air-dry	Total	Total	Per gm air-dry matter	For 10c*
					gm.	gm.	gm.			
380A	Banana and nut (25c)	One banana, ½ tbsp. mayonnaise, 1 tbsp. chopped nuts, 2 rolls, butter	B	Salad and rolls..	213	102	11.5	448	4.4	205
				Rolls	75	...	6.4	233	..	...
				Salad	138	...	5.1	215	..	145
380B	Banana and nut (25c)	Duplicate of 380A	B	Salad and rolls..	219	114	12.8	504	4.4	225
				Rolls	83	...	7.1	257	..	...
				Salad	136	...	5.7	247	..	165
322	Egg (35c)	Sliced hard-boiled egg, 17 slices each 3/16 inch thick; boiled dressing†, lettuce, 2 slices bread, butter	B	Salad and bread.	204	55	15.1	313	5.7	105
				Bread	31	...	3.0	90	..	...
				Salad	173	...	12.1	223	..	90
476	Egg (35c)	Two sliced hard-boiled eggs, lettuce, mayonnaise, 2 rolls, butter	C	Salad and rolls..	280	125	21.4	765	6.1	235
				Rolls	69	...	6.1	200	..	..
				Salad	211	...	15.3	565	..	225
281	Fruit (45c)	Apricot (4 halves), pear & peach (2 quarters each), pineapple (2 tidbits), cherries, lettuce, ½ tbsp. mayonnaise, 2 rolls, butter	D	Salad and rolls	...	129	9.0	522	4.1	135
				Rolls	71	...	6.3	206	..	...
				Salad	...	...	2.7	316	..	90
396	Pineapple and cream cheese (35c)	3 slices pineapple, 2 pieces cream cheese, lettuce, mayonnaise, 2 rolls, butter	B	Salad and rolls..	240	108	10.0	444	4.1	145
				Rolls	83	...	7.1	257	..	...
				Salad	157	...	2.9	187	..	75
395	Salmon (35c)	¾ cup salmon, mayonnaise, lettuce, 2 rolls, butter	B	Salad and rolls..	287	109	37.3	499	4.6	160
				Rolls	86	...	7.3	267	..	...
				Salad	201	...	30.0	232	..	95
477	Salmon (35c)	¾ cup salmon, 1 tbsp. mayonnaise, lettuce, 2 rolls, butter	C	Salad and rolls..	249	120	31.8	699	5.8	215
				Rolls	65	...	5.7	189	..	...
				Salad	184	...	26.1	510	..	205
418	Shrimp (35c)	1 cup shrimps, lettuce, boiled dressing†, 2 rolls, butter	B	Salad and rolls..	328	112	40.3	500	4.5	160
				Rolls	80	...	6.8	248	..	...
				Salad	248	...	33.5	252	..	100
307	Tuna fish (35c) ...	½ cup tuna fish, mayonnaise, lettuce, 2 rolls, butter	B	Salad and rolls..	228	104	31.4	495	4.8	160
				Rolls	85	...	7.2	264	..	...
				Salad	143	...	24.2	231	..	90

* Calories in average serving of butter (See Table 16, page 38) included in estimation of calories for 10 cents in salad as served with rolls and butter. Allowance of 10 cents for cost of rolls and butter made in calculating calories for 10 cents in salad alone.

† Contained no oil.

rolls alone and the salad alone being estimations. In every instance in Table 6 the weight of the rolls or bread served with the salad was determined separately from the weight of the salad. The column for calories for ten cents is the only one in which the food value of butter (See page 38) is taken into consideration, and here the results are recorded to the nearest 5 calories, because it is believed that the estimations for the butter do not justify reporting the results more closely.

The energy value of the rolls served with the salads purchased at Restaurant B is found from the data for fresh weight, total calories and total protein per portion in Table 1 (page 14) to be 3.1 calories per gram of fresh weight and the protein content 8.5 per cent (average values for Samples 29 and 75 in Table 1). The rolls served with the salads purchased at Restaurants C and D were considered to have an energy value of 2.9 calories per gram of fresh weight and a protein content of 8.8 per cent (average values for all the white rolls listed in Table 1). The bread (Sample 84) served with Salad No. 322 contained 2.9 calories per gram of fresh weight and 10 per cent protein. It is believed that these values may be used in general in estimating the calories from the fresh weight of rolls and bread.

Comparison of the fresh and the air-dry weights of the salads alone shows that there is a tremendous loss in drying, in some instances nearly 82 per cent. The total energy content and the total protein content of the salads (without rolls) vary widely, as would be expected from the variations in sizes of serving and the great difference in composition. In five out of ten instances the rolls (not including the butter) furnished as much or somewhat more energy (See Table 6) than the salad itself. The data for Salad 322, served with sliced bread rather than rolls, suggest that one can obtain nearly 150 calories more for the same price when rolls are included with the salad than when slices of bread are included.

Samples 380A and 38ϕB (Table 6) give a good illustration of the variations which may be expected in the servings of the same salad. These two salads were identical in composition, and an order of rolls was served with each. The fresh weights of the rolls were only slightly different and the fresh weights of the salads were practically the same; yet Sample 380B contains 12 per cent more energy than Sample 380A on the basis of salad plus rolls and 15 per cent more energy in the salad alone. The same comparison holds true with regard to the protein content of the two samples.

The energy per gram of air-dry matter in the salads alone (Table 5) varies from 3.7 to 4.7 calories in six instances and from 6.0 to 7.5 in five other instances. High values were expected in

Samples 51 and 37, as they were unusually greasy. The high results obtained with Samples 52 and 94 may be explained by the fact that these salads consisted for the most part of materials containing chiefly water (asparagus and lettuce), and the air-dry matter represents a larger proportion of oil (in the mayonnaise and the oil-drenched sardine) than does that in any of the other salads. The salads made with boiled dressing, on the other hand, have a low energy value per gram of air-dry matter because there is no salad oil in the dressing. This factor for the salads analyzed with rolls varies from 4.1 to 6.1 calories.

The calories for 10 cents in the salads alone range from 75 to 226. As a source of energy, therefore, the salad is somewhat more costly than the average sandwich and decidedly more costly than bread, package sandwiches, and sweetened breads.

SOUPS AND MISCELLANEOUS MATERIALS

There are innumerable miscellaneous foods which at times form a part of the diet but which cannot be classified under any one specific head. Results of analyses of a number of such foods, together with a few analyses of canned soups, are summarized in Table 7. Here again the calories per gram of air-dry matter vary according to the proportions of protein, carbohydrate, and fat in the foods.

The average energy value of the condensed soups is 3.8 calories per gram of air-dry matter, indicating that they are in large part composed of carbohydrate with possibly a small amount of fat. The cream of celery soup (No. 405), on the contrary, has an energy value of 5.7 calories per gram, or much higher than the value for carbohydrates. This high value is difficult to explain, except that the cream used may have contained considerable butter fat. The air-dry sample of this soup appeared somewhat greasy, but there was no visible fat. On the other hand, the cream of tomato soup (No. 402) appeared very greasy, although the calories per gram of air-dry matter are lower than those in No. 405. The air-dry sample of cream of tomato soup probably retained more moisture than did the cream of celery soup. In general, a sample of food presenting a greasy appearance or containing visible fat will be found to have a higher caloric value per gram of air-dry matter than one which does not appear greasy. But the presence of considerable moisture in the air-dry sample will tend to lower what would otherwise be a high caloric value.

The energy and the protein content of the soups per ten cents vary considerably, and in this respect there seems to be little advantage in purchasing the cream soups in preference to the condensed soups. The vegetable-beef soup contains the greatest amount

TABLE 7. *Canned Soups and Miscellaneous Foods.*

No.	Name and cost	Description	Weight of can or package		Protein		Calories		
			Fresh	Air-dry	Total per can or package	For 10c	Total per can or package	Per gm. air-dry matter	For 10c
	Campbell's Soups:*		gm.	gm.	gm.	gm.			
422	Asparagus		308	44	4.6	3.8	160	3.6	133
407	Chicken		314	37	8.6	7.2	138	3.8	115
406	Pea		313	75	16.3	13.6	312	4.2	260
403	Tomato		320	59	4.3	3.6	200	3.4	167
404	Vegetable		329	72	9.5	7.9	264	3.7	220
408	Vegetable-beef		316	57	23.0	19.2	242	4.3	202
	Heinz Soups:†								
405	Cream of celery‡		463	51	2.7	1.4	289	5.7	145
402	Cream of tomato§		486	83	4.9	3.3	314	3.8	209
		Miscellaneous foods							
379	Kay 25c	A jar of moist sandwich-spread, mildly flavored with cheese, containing chopped pimento and green peppers; contains ¾ cup	168	60	10.2	4.1	380	6.4	152
368	Nukraft 28c	Cheese, milk sugar, mineral salts	198	132	38.1	13.6	799	6.1	285
369	Pabst-ett 25c	Cheese, milk protein, milk sugar, and milk minerals	186	119	34.2	13.7	705	5.9	282
354	Chop Suey, Plain 45c	Sprouts, celery, onion, beef, and gravy; one pint purchased at restaurant	426	63	17.4	3.9	368	5.8	82
225	Peanuts, Salted 5c	Squirrel Brand, 135 whole peanuts in bag	47£	47£	13.3	26.6	339	7.3	678
226	Peanuts, Salted 5c	Planters, 65 whole peanuts in bag	53¶	53¶	12.6	25.2	372	7.2	744
103	Potato Chips 10c	One bag	61	60	3.6	3.6	359	6.0	359
228	Raisins 5c	Golden Vine Calif. Seedless	72	72	2.5	5.0	228	3.2	456
371	Heinz Rice Flakes 13c	Ready to serve breakfast cereal, sold in 8 oz. box; avg. weight cup of flakes, 33.5 gm.	185	185	13.4	10.3	685	3.7	527
409	Heinz Spaghetti 15c	Cooked in tomato sauce with cheese; 1 pint	507	104	11.7	7.8	394	3.8	263
421	Beech-nut Prepared Spaghetti 13c	With cheese and tomato; 1 pint	501	87	10.4	8.0	342	3.9	274

* 12 cents per can; condensed; to be diluted with an equal volume of water or milk.
† Each can contained one pint; this volume to be increased, if desired, by the addition of hot milk or cream.
‡ 20 cents per can.
§ 15 cents per can.
£ Represents weight of peanuts alone, with salt and skins removed; total weight 53 gm.

of protein for 10 cents, the pea soup the next largest amount, and the cream of celery soup the smallest amount. Evidently the flavor of the cream soups adds to their expense. It is commonly recommended that one can of soup be used to serve four people. The energy obtained in one-fourth of one of these cans would be such that the individual would receive hardly 60 calories. Hence a serving of soup, eaten without crackers or bread, is of almost negligible caloric value.

Examination of the data for the miscellaneous foods shows that the chop suey is an expensive dish, having a low protein and energy content for ten cents. Salted peanuts, on the other hand, have a high food value for ten cents. In fact, they furnish more grams of protein for this sum than any other food analyzed in this survey except the white roll (Sample 17, Table 1). Two of the cheese products (Nos. 368 and 369) are also economical sources of protein.

DESSERTS

Pie. Analyses of several samples of pie purchased in different restaurants in Durham are reported in Table 8. Owing to the large proportion of carbohydrate and the minimum amount of fat present, the energy value per gram of air-dry matter in these pies is for the most part close to 4.5 calories. Each piece of pie furnished from 3 to 8 grams of protein and from 300 to 600 calories for ten cents.

TABLE 8. *Pies**.

No.	Name	Restaurant	Weight of piece of pie		Protein	Calories	
			Fresh	Air-dry	Total per piece	Total per piece	Per gm. air-dry matter
			gm.	gm.	gm.		
88B	Apple	C	139	87	3.1	392	4.5
90	Apple	B	168	80	3.6	382	4.8
107	Apple	D	133	81	3.2	364	4.5
115	Apple	H	179	87	3.6	384	4.4
424	Apple	A	168	100	4.4	494	4.9
40	Apricot	A	119	74	4.0	346	4.7
108	Cocoanut cream	D	147	85	6.3	410	4.8
89	Cocoanut custard	B	147	68	7.7	357	5.2
112	Fig	H	189	161	4.1	620	3.9
88A	Lemon	C	159	77	4.3	309	4.0
111	Mince	B	156	110	7.1	501	4.6
113	Mince	H	180	120	4.6	480	4.0
110	Mock Cherry	B	153	126	4.4	520	4.1
41	Pineapple	A	105	65	2.9	294	4.5
114	Pineapple	H	171	101	3.9	428	4.2
423	Pineapple	A	182	121	6.0	571	4.7
109	Prune	C	135	95	3.8	390	4.1
95	Pumpkin	A	158	69	6.3	331	4.8
425	Raisin	A	174	102	5.0	495	4.9
	Minimum		*105*	*65*	*2.9*	*294*	*3.9*
	Maximum		*189*	*161*	*7.7*	*620*	*5.2*
	AVERAGE		...	...	..	...	4.5

* Average values for one piece of pie, costing 10 cents; from 2 to 4 pieces of pie used in each instance to obtain sample for combustion.

Miscellaneous desserts. Our survey took into consideration only seven of the innumerable miscellaneous desserts (see Table 9). The calories per gram of air-dry matter are highest in the whipped cream cake, owing to its fat content, but with the other desserts average 4.3, not far from the caloric value of carbohydrate. The protein content per ten cents is low. The energy content per ten cents varies from 131 to 592 calories.

TABLE 9. *Desserts.*

No.*	Name	Weight of serving		Protein	Calories	
		Fresh	Air-dry	Total per serving*	Total per serving*	Per gm. air-dry matter
		gm.	gm.			
38	Apple, baked†	209	57	0.6	232	4.1
434	Apple, baked‡	120	29	1.0	131	4.5
39	Bread pudding, cocoanut†	131	60	6.7	287	4.8
118	Cake, orange	81	67	3.6	296	4.4
106	Cake, whipped cream§	87	61	4.3	375	6.1
62	Custard, peach£	150	50	3.4	234	4.6
32	Fruit jelly†	222	56	5.6	199	3.5

* Sample 118 cost 5 cents, all the others 10 cents each.
† Served with whipped cream.
‡ Flavored with cinnamon and sugar; served with 1½ tbsp. thin cream.
§ Cake, whipped cream, chopped nuts.
£ Soft custard, sliced peaches, whipped cream.

ICE CREAM AND SHERBETS

Probably the most popular dessert in the United States is ice cream. It is sold in a great variety of flavors, is easily eaten, and has a high energy value in concentrated form. Table 10 shows the energy and the protein content of two types of ice cream, those made by the university dairy (indicated in Table 10 as manufacturer A) and those made for commercial trade (sold by manufacturers B, C, D, and E). In addition, four analyses of sherbets are reported. The State of New Hampshire requires the fat content of plain ice creams (without fruit or nuts) to be 14 per cent and that of fruit and nut ice creams 12 per cent, but analyses made at the college creamery show that the university ice creams contain 15 per cent of fat.

The half-pint servings of ice cream average about 200 grams in weight (fresh) and the total energy content is high, averaging not far from 500 calories. The total protein content is about 7 grams per half pint. The calories per gram of air-dry matter are high, in several instances 6.0 or over and in no instance under 5.0. On the average for all the ice creams this factor is 5.6.

TABLE 10. *Ice Creams and Sherbets.*

No.	Kind	Manufacturer*	Weight of serving†		Protein	Calories			
			Fresh	Air-dry	Total per serving†	Total per serving†	Per gm. fresh weight	Per gm. air-dry matter	For 10c
	Ice Creams		gm.	gm.	gm.				
346	Almond	A	201	88	9.6	531	2.6	6.0	354
136	Banana	A	226	93	6.5	513	2.3	5.5	342
202	Butterscotch	A	210	98	5.4	560	2.7	5.7	374
125	Chocolate	A	208	96	7.8	527	2.5	5.5	352
163	Chocolate	A	238	107	8.9	585	2.5	5.5	390
200	Chocolate	A	197	93	7.3	505	2.6	5.4	337
138	Chocolate	B	183	71	6.9	380	2.1	5.4	253
348	Chocolate	B	187	74	7.6	412	2.2	5.6	275
123	Maple Walnut	A	209	95	8.4	529	2.5	5.5	353
164	Maple Walnut	A	215	96	8.7	561	2.6	5.9	374
203	Maple Walnut	A	197	80	6.1	501	2.5	6.2	334
433	Maple Walnut	E	52	21	1.9†	129†	2.5	6.1	258
144	Orange Pineapple	A	204	96	6.0	493	2.4	5.1	329
184	Orange Pineapple	A	243	116	7.5	585	2.4	5.0	390
135	Raspberry	A	211	94	6.6	483	2.3	5.1	322
126	Strawberry	A	220	94	7.4	497	2.3	5.3	331
166	Strawberry	A	200	85	7.1	462	2.3	5.4	308
199	Strawberry	A	187	73	4.5	457	2.4	6.3	305
347	Strawberry	B	230	88	7.3	496	2.2	5.6	331
198	Tutti-Frutti	A	259	125	7.6	618	2.4	5.0	412
124	Vanilla	A	211	92	7.9	526	2.5	5.7	350
165	Vanilla	A	210	90	7.5	508	2.4	5.7	339
201	Vanilla	A	198	79	5.4	501	2.5	6.3	334
19	Vanilla	C	194	79	7.8	425	2.2	5.4	283
20	Vanilla	D	195	83	8.0	435	2.2	5.2	290
432	Vanilla	E	56	22	1.8†	130†	2.3	6.0	260
139	Vanilla‡	B	217	91	7.2	485	2.2	5.4	323
	University ice creams*								
	Minimum		*187*	*73*	*4.5*	*457*	..	*5.0*	*305*
	Maximum		*259*	*125*	*9.6*	*618*	..	*6.3*	*412*
	AVERAGE		...	...	..	...	..	**5.6**	...
	Sherbets								
140	Orange	B	201	76	1.4	302	1.5	4.0	201
373	Orange	B	220	76	1.7	286	1.3	3.8	191
390	Pineapple	A	258	111	4.8	376	1.5	3.4	251
175	Raspberry	A	273	113	4.7	367	1.3	3.3	245

* The university ice creams were furnished by manufacturer A, the commercial ice creams by manufacturers B, C, and D; the minimum, maximum, and average values apply only to the university ice creams.

† 15-cent, half-pint portions sold in all instances except Nos. 432 and 433, which were sold in 5-cent portions.

‡ So-called "French vanilla."

With the sherbets the energy content per gram of air-dry matter is low, averaging 3.6 calories. The total caloric content per half pint is also low, nearer 330 calories than 500 calories, as found with the ice creams. The protein content is likewise lower than that of the ice creams.

The average energy content of ice cream per ten cents (purchased by the half pint) is 330 calories, that of sherbets 220 calories. Economically, therefore, ice cream has about the same food value as many of the servings of pie and some of the package sandwiches and has a higher food value than the salads and sandwiches but not so high as that of bread and doughnuts.

For practical purposes, since ice cream is such a universal dessert or extra indulgence, we have computed the caloric content per gram of fresh weight. These results are immediately applicable to the fresh weight of the ice cream eaten, and the total energy value of a serving of ice cream or sherbet may thus be easily estimated with a fair degree of accuracy.

On three different days one 5-cent and one 10-cent ice cream cone were purchased at the college creamery (manufacturer A). The ice cream and the cones were weighed separately, and the food values of the ice cream alone and of the cone alone were calculated, based upon the analyses of ice creams from manufacturer A given in Table

TABLE 11. *Ice Cream Cones.*

Kind	Ice cream		Ice cream plus cone		For 10 cents	
	Fresh weight	Total calories	Total calories	Total protein	Protein	Calories
5-cent cone*	gm.			gm.	gm.	
Chocolate	78	195	219	3.9	..	...
Vanilla	65	163	187	3.1	..	...
Vanilla	71	178	202	3.3	..	...
Average	71	179	203	3.4	6.8	406
10-cent cone						
Chocolate	131	328	352	5.9	..	...
Vanilla	107	268	292	4.5	..	...
Vanilla	119	298	322	4.9	..	...
Average	119	298	322	5.1	5.1	322
Half-pint ice cream†	213	523	...	7.2	4.8	349

* Average weight of cone without ice cream, 6 gm.; energy value 4.0 cal. per gram; protein content 16.6 per cent. (Rose, M. S., Laboratory handbook for dietetics, New York, 3d ed., 1929, p. 172).

† Average values for 19 half-pint portions of ice cream, all flavors, purchased for 15 cents of manufacturer A (see Table 10).

TABLE 12. *Sundaes.*

No.	Name	Place where purchased	Description	Weight of serving		Protein	Calories		
				Fresh	Air-dry	Total per serving*	Total per serving*	Per gm. air-dry matter	For 10c
				gm.	gm.	gm.			
441	Banana royal	G	1 small banana, banana walnut ice cream, orange pineapple ice cream, strawberry syrup, pineapple syrup, whipped cream, nuts	281	130	5.0	583	4.5	233
429	Banana (fresh) college ice	O	Vanilla ice cream, fresh banana sauce, mixed nuts, marshmallow sauce	168	75	4.3	361	4.8	241
431	Caramel sundae	O	Vanilla ice cream, caramel sauce, peanuts	125	70	5.2	335	4.8	223
378	Chocolate nut sundae	F	Vanilla ice cream, chocolate sauce, nuts	130	64	4.8	357	5.6	238
302	Chocolate nut sundae	O	Vanilla ice cream, chocolate sauce, chopped nuts	150	77	6.2	413	5.4	275
324	Chocolate nut sundae	P	Vanilla ice cream, chocolate sauce, chopped walnuts	...	57	4.5	313	5.5	209
21	Chocolate nut sundae	Q	Vanilla ice cream, chocolate sauce, nuts	127	72	5.0	346	4.8	231
147	Chocolate nut sundae	F	Vanilla ice cream, chocolate sauce, nuts	145	73	4.5	376	5.2	251
148	Chocolate nut sundae	O	Vanilla ice cream, chocolate sauce, nuts	164	92	5.2	450	4.9	300
438	Chocolate walnut sundae	G	Chocolate ice cream, chocolate syrup, walnuts	154	77	4.9	394	5.1	263
428	Coffee butterscotch sundae	O	Coffee ice cream, butterscotch sauce, pecans	149	82	4.4	424	5.2	283
413	Fruit sundae	F	Strawberry ice cream, raspberry sauce	155	81	3.2	355	4.4	237
410	Fudge sundae	F	Vanilla ice cream, fudge sauce	124	77	3.6	349	4.5	233
411	Fudge marshmallow sundae	F	Vanilla ice cream, fudge sauce, marshmallow sauce	146	92	3.3	399	4.3	266
426	Fudge marshmallow sundae	O	Vanilla ice cream, fudge sauce, marshmallow sauce	144	82	3.8	397	4.9	265
412	Fudge nut sundae	F	Vanilla ice cream, fudge sauce, chopped nuts	134	89	4.7	419	4.7	279
442	Maple walnut sundae	G	Banana walnut ice cream, maple walnut syrup	119	54	4.0	298	5.5	199
427	Pineapple sundae	O	Vanilla ice cream, pineapple sauce	141	78	2.7	322	4.1	215
439	Pineapple (crushed) sundae	G	Vanilla ice cream, crushed pineapple sauce	137	72	3.0	326	4.5	217
415	Strawberry frappe	F	Heaping cupful strawberry ice cream beaten up in strawberry syrup	246	89	5.4	376	4.2	251
414	Strawberry ice cream soda	F	Scant cupful strawberry ice cream and strawberry syrup	285	85	3.8	351	4.1	234
440	Strawberry (crushed) sundae	G	Vanilla ice cream, crushed strawberry sauce	120	56	2.7	275	4.9	183
	Minimum			*119*	*54*	*2.7*	*275*	*4.1*	*183*
	Maximum			*285*	*130*	*6.2*	*583*	*5.6*	*300*
	AVERAGE			...	...	..	...	**4.8**	...

* Each serving cost 15c in every instance except No. 441, which cost 25c.

10 and upon the analyses of ice cream cones previously published by Rose.[1] The results are reported in Table 11. In general, only 59 per cent more energy is served in the 10-cent cone than in the 5-cent cone. In three 5-cent cones one would obtain on the average the same fresh weight of ice cream as in one half-pint box costing 15 cents but the average total calories in the three 5-cent cones would be somewhat greater than the average total calories in the 15-cent servings of ice cream, probably due to the energy value of the cones. Comparisons of the protein and the calories for ten cents show the highest values in the case of the 5-cent cone.

SUNDAES

In recent years ice cream covered with various sauces and frequently also with chopped nuts has had a great vogue under the special name of "Sundae." These almost invariably cost fifteen cents. A number were analyzed, and the results are given in Table 12. The energy value of the sundaes per gram of air-dry matter is lower than that of ice cream alone, averaging 4.8 calories. The total protein content is also lower in most instances, even with the sundaes containing nuts. The energy value per ten cents is about 250 calories or nearly 100 calories less than in the ice creams.

MILK SHAKES

The analyses of three special milk beverages, the so-called "milk shakes," are listed in Table 13. These did not contain ice cream. The banana premulger consisted of one whole, fresh banana whipped up in milk. The two chocolate milk shakes were made of cocoa syrup and milk, the volume of each being one pint. In the chocolate milk shakes the total energy content is from 450 to 500 calories and the protein content from 14 to 15 grams. Hence the chocolate milk shake sold at ten cents per pint is an inexpensive food.

TABLE 13. *Milk Shakes.*

No.	Name	M'n'fr.	Cost	Weight		Protein	Calories		
				Fresh	Air-dry	Total	Total	Per gm. air-dry matter	For 10c
			cents	gm.	gm.	gm.			
430	Banana Premulger	O	15	228	61	4.3	252	4.2	168
137	Chocolate milk .	A	10	506	93	14.3	448	4.8	448
391	Chocolate milk .	A	10	506	100	15.4	497	5.0	497

(1) Rose, M. S., A Laboratory handbook for dietetics, New York, 3d ed., 1929, p. 172.

TABLE 14. *Candies.*

No.	Group and name	Description	Cost	Weight as purchased	Protein	Calories			No.
					Total	Total	Per gm.	For 10c	
			cents	gm.	gm.				
	Chocolate Nut Bar or Chocolate-covered nuts								
231	Dow's Chocolate-covered Peanut Bar		5	57	9.8	346	6.1	692	231
233	Hershey's Almond, Sweet Milk Chocolate	Whole almonds in sweet milk chocolate	5	31	3.0	194	6.3	388	233
259	Mr. Goodbar	Peanuts in milk chocolate	5	51	8.1	325	6.4	650	259
367	Texas Pecans — Sweet Milk Chocolate	Box of 10 or 12 whole pecans, coated with chocolate	5	27	1.7	177	6.6	354	367
	Milk Chocolate								
224	Hershey's Sweet Milk Chocolate		5	40	3.0	238	6.0	476	224
230	Handy	Unwrapped	10	86	4.8	507	5.9	507	230
363	Peter's Croquettes	7 wafers in package, wrapped separately	10	45	3.5	267	6.0	267	363
364A	Toblerone Swiss Milk Chocolate	With almonds and honey	5	22	1.4	120	5.5	240	364A
364B	Toblerone Swiss Milk Chocolate	Same as No. 364A	10	44	2.9	244	5.5	244	364B
385	Fi-na-st Milk Chocolate		3 for 25	96	6.1	557	5.8	668	385
	Chocolate Coated Candy Nut and Caramel Center								
219	Copy of Oh Henry	Caramel, molasses, and peanut center, thin chocolate coating	5	64	7.9	341	5.4	682	219
336	Oh Henry	Fudge center, surrounded by caramel and peanut layer, chocolate coated	10	96	9.0	464	4.8	464	336
387	Oh Henry	Same as No. 336	5	55	5.7	274	4.9	548	387
25	Oh Henry	Same as No. 336	10	109	12.1	553	5.1	553	25
332	Chewy Nut Loaf	Firm cream center covered with peanuts and coated with chocolate	5	50	4.4	246	5.0	492	332
26	Chewy Nut Loaf	Same as No. 332	5	48	5.0	240	5.0	480	26
211	Oh Wally	Cream center, layer of peanuts held by caramel, chocolate coated	5	59	5.4	273	4.6	546	211

			cents	gm.	gm.				
	Cocoanut Cream Center								
205	Snow Drifts	Cocoanut cream center, chocolate coated on bottom and sides	5	51	2.2	270	5.3	540	205
223	Milkmaks	Cocoanut center, chocolate coated, in paper cup	5	41	1.3	215	5.3	430	223
242	Chocolate Cocoanut Mounds	Cocoanut center, chocolate coated	5	53	2.2	274	5.2	548	242
334	Needhams	Cocoanut cream center, chocolate coated.	5	56	1.9	261	4.7	522	334
335	Koko-ruff	Cocoanut cream center, chocolate coated .	5	56	2.0	263	4.7	526	335
121	Waleco Cocoanut Bar .		5	63	1.5	262	4.1	524	121
	Firm Center with Few or No Nuts								
220	Necco Bolster	Brittle center flavored with molasses and peanut butter, chocolate coated	5	62	3.9	298	4.8	596	220
218	Waleco-Rarin' to Go...	Brittle center flavored with molasses and chocolate, chocolate coated	5	55	4.1	263	4.8	526	218
221	Washburn's Big Tim ..	Brittle center, peanut and molasses flavored, chocolate coated	5	61	4.1	281	4.6	562	221
235	Chop Suey, the Wonder Confection	Chocolate colored chewy center, chocolate coated	5	67	1.4	322	4.8	644	235
234	Denver Sandwich	Thin layers of nabisco and sugar filling, surrounded by soft caramel and peanut layer; chocolate coated	5	50	3.3	243	4.9	486	234
232	Snappy	Nabiscos and cream filling, surrounded by caramel, chocolate coated	5	52	3.1	249	4.8	498	232
	Soft Center with Many Nuts								
222	Spanish Nougat	Nougat center with peanuts, chocolate coated, not wrapped	2 for 5c	30	1.3	138	4.6	552	222
217	Sam'n' Henry	Chocolate marshmallow with strip of caramel through center, peanuts, chocolated coated	5	44	2.3	200	4.6	400	217
27	Cream Walnut Bar ...		5	51	1.2	237	4.6	474	27
	Soft Center with Few or No Nuts								
303	Necco Chocolate Peppermints	Box of 8 peppermints, cream center, chocolate coated	5	55	0.8	229	4.2	458	303
370	Brigg's Chocolate Peppermints	Box of 8 pieces, chocolate coated	5	56	1.1	238	4.2	476	370
382	Fi-na-st Chocolate Peppermints	Box of 8 pieces, chocolate coated	3 for 10	47	1.0	207	4.4	621	382
384	Chocolate Peppermint Pattie		3 for 10	56	0.8	227	4.0	681	384

TABLE 14 (*Continued.*) *Candies.*

No.	Group and name	Description	Cost	Weight as purchased	Protein	Calories			No.
					Total	Total	Per gm.	For 10c	
	Chocolate Coated Candy Soft Center with Few or No Nuts (Cont'd.)		cents	gm.	gm.				
389	Panglo Chocolate Mints	Box of 14 pieces peppermint cream center with thin coating of chocolate	5	39	0.3	163	4.2	326	389
388	Del-mont Nutty Nougat	Nougat with peanuts, chocolate coated	5	71	2.2	286	4.1	572	388
207	Fat Emma	Marshmallow center with an occasional nut, chocolate coated	5	43	1.8	185	4.3	370	207
209	Chocolate Fig Sundae	Marshmallow folded over fig jam, thin chocolate coating	5	47	1.2	193	4.1	386	209
330	Butter Cream Bar	Not wrapped, firm cream center, chocolate coated	5	50	3.4	207	4.2	414	330
333	Butterscotch and Cream Pattie	Sold in paper cup, soft cream center, layer of soft butterscotch, chocolate coated	5	50	0.9	216	4.3	432	333
338	Caramel Cream Pattie	Sold in paper cup, caramel flavored cream center, chocolate coated	5	49	1.1	205	4.2	410	338
331	Fruit Cream Pattie	Sold in paper cup, soft cream center, flavored with raspberry and orange, chocolate coated	5	50	0.8	207	4.2	414	331
206	Kid Boots	Soft cream center, chocolate coated	5	55	1.7	240	4.4	480	206
210	Mary Ellen Fudge	Chocolate fudge center, chocolate coated	5	53	1.5	235	4.4	470	210
6	Necco Mint Pattie	Peppermint cream center, chocolate coated	5	61	1.3	242	4.0	484	6
	Miscellaneous, not Chocolate Coated With Many Nuts								
213	Nut Tootsie Rolls	6 sections in roll, chocolate flavored with peanuts	5	38	1.0	156	4.1	312	213
204	Chocolate Honeys	With toasted almonds, 5 sections, wrapped separately, in box	5	46	1.2	186	4.0	372	204
237	Jersey Bar	Caramel bar with small pieces of nuts	5	67	2.0	272	4.1	544	237
236	O-La-Dy	Nougat center with nuts, strips of caramel, and chopped peanuts on top and bottom	5	55	4.4	238	4.3	476	236
208	Tiger Bar	Maple flavored, with pieces of walnut	5	48	0.9	198	4.2	396	208
215	Bit-O-Honey	Chewy consistency, whole almonds scattered through bar	5	51	2.1	214	4.2	428	215

362	Goldco Nougat Bar ...	With chopped nuts	5	60	3.6	238	4.0	476	362
	Without Nuts								
365	Goldco Jelly Roll	Gum drops, assorted flavors, rolled in sugar, 7 in glassine wrapper	5	65	0.1	203	3.2	406	365
229	Ye Old Fashioned Molasses Candy	A slab of molasses taffy	5	64	0.2	218	3.4	436	229
227	Corn Cakes	Popcorn with molasses syrup, pressed together and cut	5	39	1.9	148	3.8	296	227
383	Fi-na-st Candy Wafers.	55 wafers assorted colors and flavors, in roll	3 for 10	78	0.3	293	3.7	879	383
366	Necco Sweets	Roll of 8 pieces in glassine wrapper, assorted flavors and colors	5	62	..	217	3.5	434	366
216	Chocolate Candy Lunch Tootsie Rolls	6 sections in roll, chocolate flavored	5	50	0.5	199	4.0	398	216
214	Butterscotch Tootsie Rolls	6 sections in roll, butterscotch flavor	5	55	0.1	212	3.8	424	214
212	Molasses Tootsie Rolls.	6 sections in roll, molasses flavored	5	50	0.1	196	3.9	392	212
437	Honey Scotch	10 caramels wrapped separately in box ..	5	51	0.6	205	4.0	410	437
318	Clove Life Savers	14 pieces in roll	5	21	..	79	3.8	158	318
7	Pep-O-Mint Life Savers	14 pieces in roll	5	21	..	81	3.9	162	7
436	Waleco Jumbo Cocoanut Cake	Cocoanut cake, browned on outside, sold in paper cup	5	56	1.6	266	4.8	532	436

CANDY

All youth, particularly American youth, may be said to be addicted to candy, and the consumption of candy in the convenient, attractive packages now sold by the manufacturers, usually at a standard price of 5 or 10 cents, is an easy, rapid method of securing a digestible and palatable carbohydrate. Large numbers of these packages of candy are sold, and every month there is an addition to the innumerable brands appearing on the market. We included sixty-six samples of candy in our survey. The results are given in Table 14, the candies being grouped according to their general composition. In all cases they were wrapped in packages, unless otherwise stated in the description given in the third column of the table. The air-dry weight of the candy was determined in a few instances, but for the most part the candies were dry enough, as purchased, to be burned. In Table 14, accordingly, we have recorded the fresh weight of the candy, as purchased, and the calories per gram are given on the basis of the weight as purchased. The values for the weight, the total calories, and the total protein are for one bar, one package, or one roll of the candy in each case. These values are in most instances *averages*, however, since usually 3 or 4 bars of candy were included in each sample for analysis.

From the data in Table 14 average values according to general composition have been prepared for the caloric content of the candies per gram and per ounce of weight, as purchased. These factors are given in Table 15. Per gram of weight as purchased, the values range from 6.4 calories with the group of chocolate nut bars or chocolate-covered nuts to 3.7 calories with the miscellaneous candies not chocolate-coated and containing no nuts. The higher value is undoubtedly due to the fat content of the chocolate and the nuts. With

TABLE 15. *Average Caloric Value of Package Candies According to Composition.*

Type of candy	Calories	
	Per gram as purchased	Per ounce as purchased
Chocolate nut bar or chocolate covered nuts	6.4	180
Milk chocolate	5.8	165
Chocolate coated candy:		
Nut and caramel center	5.0	140
Cocoanut cream center	4.9	140
Firm center with few or no nuts / Soft center with many nuts	4.7	135
Soft center with few or no nuts	4.2	120
Miscellaneous, not chocolate covered:		
With many nuts	4.1	115
Without nuts	3.7	105

the factors in Table 15 one can estimate the calories in the standardized packages of candy with a fair degree of accuracy by examining the candy to determine the nature of the filling, weighing the candy in grams, and multiplying this weight by the factor for calories per gram as purchased, according to the nature of the candy. A more rapid estimation, though not so accurate, may be arrived at by applying the factors per ounce against the claimed weight in ounces given on the wrapper. The protein content is highest in the chocolate-covered nut candies, as would be expected. Almost 10 grams of protein, for example, were found in the 5-cent peanut bar, Sample 231, 8 grams in Samples 259 and 219, and 12 grams in Sample 25. The candies not chocolate coated and not containing nuts, on the contrary, have a protein content in most instances of only half a gram or less.

In these candies the calories for ten cents range from 879 with Sample 383 to 160 with Samples 318 and 7. On the average one can obtain not far from 450 calories for ten cents in this form of food. Candies, therefore, not only furnish a quick source of calories but are distinctly economical.

MEALS

Perhaps the most satisfactory service which can be rendered by a calorimetric survey of this type is to secure information concerning the energy value of the total food consumed during the three chief meals of the day. Samples of characteristic meals were obtained at the college cafeteria and at a number of different restaurants, not only in Durham and Dover, New Hampshire, but in Boston. The data are of importance locally in giving an idea of the actual food consumption at different meals of a large number of students and of importance generally in indicating the relation between the air-dry matter and the total calories in a mixed meal. The information suggests a simple method of estimating the energy intake in a mixed meal or in the total food consumed during the day, requiring only a knowledge of the air-dry weight of the food.

In analyzing these meals any bread and soup served were included in the sample, but the butter and the drink (tea, coffee, or milk) and the milk or cream and the sugar for the cereal and the drink were not included. The amounts of energy and protein obtainable in these foods will vary not only with the size of the serving but with the use customary to the individual. We did not make any combustions of these foods, but did find the average weight of a pat of butter at each restaurant. The sugar in the restaurants where these meals were purchased was served in a covered container on the table. The cream for the tea and coffee was in small individual pitchers, when not in the beverage itself. The milk for the cereal

was in a large pitcher, so that any amount might be taken. At the time when the food samples were purchased, milk was sold by the glass, each glass holding approximately three-quarters of a cup.[1] The energy and the protein content of the butter, sugar, cream, and milk have been calculated from previously published analyses of these foods, and the results are given in Table 16. These indicate that several hundred calories and several grams of protein may easily be added to a meal by the inclusion of these foods, depending upon how liberally an individual serves himself.

TABLE 16. *Butter, Sugar, Cream, and Milk**.

Food	Measure	Protein	Calories
		gm.	
Butter—average servings ...			
Restaurant A	13 gm.	0.1	100
Restaurant B	8 gm.	0.1	60
Restaurant C	7 gm.	0.1	55
Restaurant D	10 gm.	0.1	75
Sugar (granulated)	Silver teaspoon† ..... (7.4 gm.)	..	29
Cream (thin)	1 tablespoon	0.4	28
Milk (whole)	¼ cup	2.1	42
	1 glass (¾ cup)	6.2	127
	½ pint	8.3	170
	1 pint	16.5	339
	1 quart	33.0	678

* The values in this table are based on data given by Rose, M. S., Feeding the family, New York, 1916 and 1925; ibid., Laboratory handbook for dietetics, New York, 1923, pp. 33 and 45. Butter assumed to contain 7.69 cal. per gm. and 1 p. ct. protein; milk 4 p. ct. fat, 0.69 cal. per gm., and 3.3 p. ct. protein.

† Average of 3 servings (not level teaspoonfuls) by each of 17 individuals. Benedict, C. G., and F. G. Benedict, Boston, Med. and Surg. Journ., 1919, 181, p. 415.

BREAKFASTS

Analyses of the breakfasts, all secured at the college cafeteria, are given in Table 17. Those which sold regularly for 25 cents afforded a choice of fruit or cereal, egg or bacon, toast or muffins, and tea, coffee or milk. The other breakfasts were purchased at so much an item (10 cents for fruit, 10 cents for cereal, and 5 cents for toast) and were purposely selected to contain only fruit, cereal and toast. An additional charge of 5 cents would have been made for the drink. The toast was unbuttered in every instance, the butter being served in a pat separately. The samples of breakfasts, as analyzed, did not contain butter or sugar and milk for the cereal or drink, but

(1) The law in New Hampshire now requires that milk be sold in public eating places in half-pint bottles, but in our calculations of the calories for 10 cents in these mixed meals, if milk was included in the cost of the meal, the energy content of the milk has been considered to be equivalent to that in one glassful and not in one half-pint.

TABLE 17. *Breakfasts.*

No.	Fruit	Cereal	Bread	Miscellaneous	Air-dry weight	Protein		Calories		
						Total in breakfast*	For 10c†	Total in breakfast*	Per gm. air-dry matter*	For 10c†
					gm.	gm.	gm			
127	———	Cornflakes	Bran muffins	Bacon	178	16.4	9.9	765	4.3	425
128	Banana	———	Toast	Fried egg	67	9.1	6.2	289	4.3	205
132	Prunes	———	Toast and doughnut	Dropped egg	137	14.6	8.4	604	4.4	330
134	———	Puffed wheat	Muffins	Bacon	118	14.8	9.3	545	4.6	335
152	———	Wheatena	Bran muffins	Scrambled egg	126	20.5	11.6	610	4.8	365
159	———	Cream of wheat	Muffins	Dropped egg	121	8.3	6.7	520	4.3	325
161	Prunes	———	Toast	Sausage	103	15.6	8.8	494	4.8	290
162	———	Wheatena	Toast	Dropped egg	86	14.7	9.2	379	4.4	270
168	———	Puffed wheat	Toast	Fried egg	71	11.9	8.1	335	4.7	255
169	Blueberries	———	Toast	Bacon	62	7.9	5.7	320	5.1	220
170	———	Cornflakes	Toast	Bacon	77	9.1	7.0	348	4.5	260
171	Peach	———	Toast	Dropped egg	71	11.5	7.1	301	4.2	210
174	———	Wheatena	Toast	Dropped egg	85	13.3	8.7	358	4.2	260
178	———	Shredded wheat	Toast	Dropped egg	97	14.8	9.3	405	4.2	280
182	Sliced peaches	———	Toast	Scrambled egg	93	20.7	10.8	475	5.1	280
196	Orange marmalade	———	Toast	Dropped egg	91	10.0	6.5	396	4.2	250
457	Banana	———	Toast	Bacon	78	9.3	6.2	372	4.8	240
158	Orange marmalade	Shredded wheat	Toast	———	118	18.4	8.2	439	3.7	245
179	Prunes	Cornflakes	Toast	———	88	5.9	3.2	328	3.7	200
181	Prunes	Shredded wheat	Toast	———	98	7.8	4.0	358	3.7	210
185	Prunes	Puffed wheat	Toast	———	77	5.3	3.0	279	3.6	180
186	Melon	Wheatena	Toast	———	77	9.5	4.7	287	3.7	185
190	Prunes	Wheatena	Toast	———	91	8.5	4.3	351	3.9	210
191	Melon	Puffed wheat	Toast	———	49	5.8	3.2	193	4.0	145
195	Prunes	Cornflakes	Toast	———	89	6.7	3.6	339	3.8	205
458	Prunes	Wheatena	Toast	———	108	10.2‡	4.1	441‡	4.1‡	230
				Minimum	*49*	*5.3*	*3.0*	*193*	*3.6*	*145*
				Maximum	*178*	*20.7*	*11.6*	*765*	*5.1*	*425*
				AVERAGE	..	...	...	...	4.3	...

* Not including butter and drink, or sugar and milk for cereal.

† Including butter, sugar, and ¼ cup of milk for cereal in all instances; glass of milk also included in estimations for breakfasts 127 to 457, incl.; no drink served with breakfasts 158-458, incl.

‡ Milk for cereal included in sample.

the estimations in Table 17 of the protein and the calories for 10 cents in these meals do include the food values of these accessories, based upon the data given in Table 16.

The data in Table 17 show that in general the lower energy values per gram of air-dry matter (4.1 calories and below) are found with the breakfasts composed of fruit, cereal and toast, and the higher values with the breakfasts which include egg or bacon. The breakfasts containing scrambled eggs are exceptionally high in protein.

DINNERS

The data for seventy-two dinners which were analyzed are given in Table 18, grouped according to the restaurant at which they were purchased. The dinners at Restaurants A, B, C, and D cost 45 cents in every instance except No. 289, which cost 40 cents. The dinners at Restaurants N and R and Nos. 357 and 358 at Restaurant Z cost 50 cents each. Nos. 359 and 361 at Restaurant Z were 45 cents each, and No. 360 was 60 cents.

Butter and a choice of tea, coffee or milk, and in the case of Restaurant D a carbonated beverage, such as ginger ale,[1] were included in the charge made for each meal, but these were not in the samples as made up for analysis. In estimating the calories and the protein for ten cents in these dinners, we have for Restaurants A, B, C, and D included the food value of butter and of one glass of milk (based on Table 16), assuming that milk was the drink selected in each instance. Since thick cream was not used at these restaurants, we estimate that a cup of coffee or tea would not contain more calories than a glass of milk and certainly could not furnish more protein. Thus our calculations on the 10-cent basis are maximum rather than minimum values. The calories and the protein for ten cents in the dinners at Restaurants N, R, and Z have not been calculated, for the choice of drinks did not include milk in every instance, we have no idea how much cream was included in the meal, and at Restaurant Z a so-called "savita sandwich" was served, the heat of combustion of which we did not determine.

The dinners at Restaurant Z were purchased at one of the Childs restaurants.[2] The values in parentheses against the various food items in these meals represent the approximate protein calories (first value) and the approximate total calories (second value) claimed by

(1) It is estimated that an 8-ounce bottle of ginger ale (the size served at restaurant D) would contain about 70 calories. See Benedict, C. G., and F. G. Benedict, Boston Med. and Surg. Journ., 1918, 179, p. 153.

(2) See the earlier survey of meals served at Childs restaurants, made by Gephart and Lusk. Analysis and cost of ready-to-serve foods. Chicago, 1915.

the restaurant to be in that particular portion of the meal. The small letter v is the symbol used by Childs restaurants to indicate that this serving contains vitamines, and the capital letter V that the serving is rich in vitamines. The total calories in these dinners, as found by our analyses, are higher in three and lower in two instances than claimed by the restaurant. We wish to emphasize here, however, that Childs restaurants do not guarantee to sell a definite number of calories in these meals. They are selling a certain food combination and any difference between the caloric content as claimed by them (stated expressly to be "approximate") and as found by our analyses must not be looked upon as a misrepresentation by this chain of restaurants. We have every reason to believe that a serious effort has been made on their part to secure standardization in their meals from the standpoint of caloric content, and the difficulty of serving the same sized portions each time explains the differences in the claimed and found energy content.

Comparison of the fresh and the air-dry weights of the dinners in those instances when both weights were recorded emphasized the large proportion of moisture existing in a seemingly large meal. The air-dry matter in Nos. 327 and 455, for example, amounted to less than one-third of the total fresh weight. Indeed, in only five instances did the air-dry matter in any of the dinners exceed 250 grams or 9 ounces.

An arrangement of the data for the dinners according to the main course, whether meat, fish, or salad, showed no pronounced differences in the food values for the various groups. It is evident that the soup, vegetable, and dessert combined play as great a role in the energy and the protein value of a meal as the serving of meat or fish. Indeed, it is believed that the variety of desserts offered at Restaurant A is partly responsible for the wide range in total energy content of the dinners purchased at this restaurant.

The calories per gram of air-dry matter are in most instances fairly uniform at between 4.5 and 5.1 or 5.2 calories. One low value of 3.7 calories was found with No. 167, undoubtedly explained by the fact that this dinner was composed chiefly of carbohydrates with practically no fat. One high value of 5.7 calories is also noted with No. 301, attributable possibly to the fat in the roast pork. The average value for all the dinners is 4.7 calories.

SUPPERS

Analyses of fifty-nine suppers from six different restaurants are given in Table 19. As with the dinners, the butter and any drink served were not included in the analyses, but their food values have

TABLE 18. *Dinners.*

No.	Description	Air-dry weight	Protein		Calories		
			Total in dinner*	For 10c†	Total in dinner*	Per gm. air-dry matter*	For 10c†
	Restaurant A	gm.	gm.	gm.			
48	Pea soup, crackers, roast pork, dressing, mashed potato, carrots, graham rolls, rice pudding	355	57.9	14.3	1610	4.5	410
60	Bouillon, roast beef, mashed potato, gravy, stewed corn, roll, muffin, Indian pudding	282	49.5	12.4	1470	5.2	375
120	Broth, braised beef, gravy, baked potato, string beans, bread, loganberries	208	37.5	9.7	866	4.2	245
149	Vegetable soup, creamed chicken, mashed potato, carrots, corn-cake, corn muffin, blueberries	169	22.9	6.5	745	4.4	215
150	Tomato soup, boiled ham, mashed potato, spinach, bread, biscuit, apple sauce, gingerbread	172	25.3	7.0	688	4.0	205
153	Soup, crackers, lamb chop, gravy, mashed potato, cabbage, bread, lemon gelatine, whipped cream	134	27.1	7.4	648	4.8	195
154	Soup, saltines, tomato and cucumber salad (no mayonnaise), mashed potato, beets, bread, rice pudding, whipped cream	131	15.1	4.8	539	4.1	170
157	Cream soup, baked sword fish, mashed potato, peas, biscuits, fruit pie	285	47.3	11.9	1260	4.4	330
160	Tomato soup, ham, baked potato, gravy, lima beans, muffins, frosted cake	251	36.4	9.5	1110	4.4	295
167	Broth, fruit salad (no mayonnaise), baked potato, gravy, tomato, bread, cherries	139	9.9	3.6	517	3.7	165
172	Broth, meat pie, mashed potato, biscuit, peas, lemon meringue pie	254	47.3	11.9	1150	4.5	305
173	Vegetable soup, crackers, corn on cob, baked haddock, sweet potato, corn cake, bread, grapenuts pudding	215	35.0	9.2	923	4.3	255
176	Pea soup, crackers, tuna fish salad (no mayonnaise), corn on cob, mashed potato, gravy, bread, melon	242	60.0	14.7	1150	4.8	305
180	Broth, crackers, beef stew, baked potato, spinach, bread, steamed pudding	212	44.1	11.2	1000	4.7	275
183	Cream soup, crackers, chicken pie, mashed potato, carrots, bread, peach	208	37.3	9.7	918	4.4	255
187	Cream soup, crackers, creamed cod, mashed potato, tomatoes, bread, loganberries	209	28.2	7.7	907	4.3	250
192	Broth, crackers, hamburg steak, mashed potato, gravy, squash, bread, melon	151	30.1	8.1	696	4.6	205

197	Pea soup, crackers, roast beef, baked potato, gravy, spinach, bread, melon	162	37.7	9.8	742	4.6	215
446	Cream of tomato soup (152 gm.), crackers (15 gm.), cucumber salad (136 gm.; sliced cucumber, lettuce, mayonnaise), mashed potato (⅜ cup), gravy, spinach (75 gm.), graham bread (26 gm.), white roll (38 gm.), pineapple (2 slices), frosted cake (28 gm.).	157	17.8	5.4	669	4.3	200
447	Bouillon (126 gm.), crackers (16 gm.), roast pork (85 gm.), stuffing (81 gm.), mashed potato (1/3 cup), gravy, wax beans, (¾ cup), graham bread (54 gm.), rhubarb sauce (120 gm.)	220	44.1	11.2	1050	4.8	285
448	Bouillon (152 gm.), crackers (15 gm.), gelatine salad (192 gm.; asparagus, celery, and tomato in gelatine, lettuce), mashed potato (157 gm.), wax beans (½ cup), roll (38 gm.), bread (22 gm.), squash pie (131 gm.), cheese (16 gm.).	202	26.7	7.3	888	4.4	250
450	Broth with spaghetti (160 gm.), crackers (15 gm.), roast lamb, gravy, mashed potato (92 gm.), beets (55 gm.), bread (58 gm.), chocolate pudding with whipped cream (120 gm.).	180	35.6	9.3	903	5.0	250
451	Chicken broth with rice (120 gm.), crackers (15 gm.), tuna fish salad (160 gm.; with pineapple, lettuce, mayonnaise), mashed potato (116 gm.), corn (65 gm.), bread (23 gm.), graham roll (45 gm.), Indian pudding with whipped cream (117 gm.).	218	36.1	9.4	1030	4.7	280
452	Broth (121 gm.), crackers (15 gm.), roast ham (40 gm.), mashed potato (70 gm.), corn (69 gm.), bread (16 gm.), graham roll (44 gm.), banana custard with whipped cream (110 gm.)	160	26.5	7.3	729	4.5	210
455	Tomato soup (94 gm.), cracker (7 gm.), creamed chicken (131 gm.), mashed potato (105 gm.), spinach (¼ cup), white roll, graham bread, tapioca pudding with meringue (121 gm.).	182	37.6	9.8	822	4.5	235
456	Tomato soup (91 gm.), crackers (16 gm.), tomato salad (104 gm.; sliced tomato, lettuce, Russian dressing), mashed potato (101 gm.), kidney beans (80 gm.), graham bread, white roll, pineapple pie (122 gm.).	216	20.8	6.0	941	4.4	260
459	Tomato soup with rice (132 gm.), crackers (15 gm.), fried ham (22 gm.), fried egg (49 gm.), mashed potato (87 gm.), boiled cabbage (90 gm.), bread (64 gm.), peach (6 slices).	152	29.1	7.9	705	4.7	205
460	Tomato soup with rice (142 gm.), crackers (15 gm.), corned beef, mashed potato (½ cup), gravy, onions (119 gm.), bread (64 gm.), tapioca pudding (166 gm.).	202	36.5	9.5	906	4.5	250
463	Cream soup (176 gm.), crackers (16 gm.), baked mackerel (69 gm.), mashed potato (85 gm.), tartar sauce (10 gm.), tomato (105 gm.), bread and roll (69 gm.), rhubarb sauce (60 gm.).	185	33.4	8.8	937	5.1	260
464	Cream soup (140 gm.), crackers (14 gm.), fried haddock (86 gm.), mashed potato (74 gm.), tartar sauce (9 gm.), peas (83 gm.), bread and roll (68 gm.), canned grapefruit (136 gm.)	191	38.6	10.0	951	5.0	260

* Not including butter and drink.
† Including butter and, in the case of restaurants A, B, C, and D one glass of milk (see Table 16).
‡ "Savita sandwich" served with this dinner; not included in sample for anlaysis. Weighed 22 gm.; estimated energy content 90 cals.

TABLE 18 (*continued*). *Dinners*

No.	Description	Air-dry weight	Protein		Calories		
			Total in dinner*	For 10c†	Total in dinner*	Per gm. air-dry matter*	For 10c†
	Restaurant A (cont'd.)	gm.	gm.	gm.			
467	Bouillon (146 gm.), chicken pie, mashed potato, wax beans (69 gm.), graham rolls (77 gm.), canned peach (6 slices).	186	31.2	8.3	822	4.4	235
468	Bouillon, crackers (2), salmon salad (207 gm.; with lettuce, celery, mayonnaise), mashed potato (1 cup), gravy, tomato (110 gm.), raisin bread, white bread, bread pudding (128 gm.; with raisins, jelly, meringue).	236	47.7	12.0	1130	4.8	300
469	Cream of tomato soup (11 gm.), crackers (15 gm.), cream cheese and tomato salad (87 gm. cheese), mashed potato (101 gm.), string beans (80 gm.), bread (45 gm.), whipped cream cake (73 gm.).	188	33.7	8.9	947	5.0	260
470	Cream of tomato soup (½ cup), crackers (2), boiled halibut, cream sauce, mashed potato (½ cup), stewed tomatoes (½ cup), bread, corn cake, fruit shortcake (baking powder biscuit, pineapple, banana, and whipped cream).	208	39.4	10.2	965	4.6	265
	Minimum	...	*9.9*	*3.6*	*517*	*3.7*	*165*
	Maximum	...	*60.0*	*14.7*	*1610*	*5.2*	*410*
	AVERAGE	...	...	...	...	**4.5**	...
	Restaurant B						
257	Fish chowder, boiled salmon, white sauce, mashed potato, stewed corn, bread (26 gm.), chocolate cornstarch pudding	142	43.1	11.0	658	4.6	190
258	Fish chowder, pot roast, gravy, mashed potato, stewed tomato, bread (30 gm.), chocolate cornstarch pudding.	127	38.0	9.8	656	5.2	185
260	Vegetable soup, cracker, roast lamb, mashed potato, gravy, peas, bread (24 gm.), raspberry gelatine with whipped cream.	101	27.7	7.6	495	4.9	150
261	Vegetable soup, cracker, sausages, mashed potato, gravy, succotash, bread (30 gm.), raspberry gelatine with whipped cream. ..	145	26.7	7.3	795	5.5	220
266	Vegetable broth, cracker, chicken pie, (cubed potatoes, chicken, gravy, pastry), bread (29 gm.), chocolate cornstarch pudding...	104	19.9	5.8	573	5.5	170
300	Fish chowder (142 gm.), baked blue fish (97 gm.), stuffing, white sauce, mashed potato (81 gm.), bread (33 gm.), string beans (44 gm.), maple walnut ice cream (55 gm.).	126	35.4	9.3	616	4.9	180

301	Fish chowder (144 gm.), roast pork (69 gm.), string beans (47 gm.), mashed potato (½ cup), gravy, bread (31 gm.), maple walnut ice cream (62 gm.).	126	27.5	7.5	721	5.7	200
304	Vegetable soup (113 gm.), roast pork (61 gm.), beets (48 gm.), mashed potato (½ cup), gravy, bread (30 gm.), tapioca pudding (57 gm.).	108	24.1	6.8	549	5.1	165
305	Vegetable soup (138 gm.), roast beef (62 gm.), gravy, mashed potato (½ cup), string beans (53 gm.), bread (37 gm.), tapioca pudding (50 gm.).	108	26.0	7.2	532	4.9	160
309	Pea soup (110 gm.), cracker (6 gm.), chicken pie (194 gm.; potato, chicken, gravy, pastry), bread (28 gm.), lemon jello with whipped cream (55 gm.).	121	22.8	6.5	613	5.1	180
310	Pea soup (145 gm.), cracker (6 gm.), pot roast (61 gm.), mashed potato (73 gm.), gravy, stewed corn (51 gm.), bread (31 gm.), lemon jello with whipped cream (58 gm.).	125	27.4	7.5	634	5.1	180
314	Tomato soup (133 gm.), cracker (7 gm.), corned beef (40 gm.), potato (68 gm.), vegetables (209 gm.; cabbage, beet, turnip, carrot), bread (23 gm.), cottage pudding (42 gm.)	132	21.1	6.1	668	5.1	190
315	Tomato soup (146 gm.), cracker (6 gm.), roast beef (60 gm.), mashed potato (½ cup), gravy, peas (64 gm.), bread (29 gm.), cottage pudding (45 gm.).	132	24.4	6.8	672	5.1	190
316	Fish chowder (130 gm.), cracker (7 gm.), baked halibut (95 gm.), white sauce, mashed potato (½ cup), string beans (40 gm.), bread (27 gm.), baked apple (101 gm.).	122	31.6	8.4	538	4.4	160
317	Fish chowder (126 gm.), cracker (7 gm.), roast veal, mashed potato (1/3 cup), gravy, string beans, (53 gm.), stuffing (61 gm.), bread (25 gm.), baked apple.	121	33.9	8.9	544	4.5	160
319	Corn chowder (116 gm.), cracker (7 gm.), roast lamb (59 gm.), mashed potato 1/3 cup), gravy, peas (50 gm.), bread (33 gm.), chocolate cornstarch pudding (65 gm.).	110	28.4	7.7	526	4.8	160
320	Corn chowder (137 gm.), cracker (7 gm.), roast beef (71 gm.), mashed potato (¼ cup), gravy, peas (44 gm.), bread (31 gm.), chocolate cornstarch pudding (63 gm.).	110	27.6	7.5	553	5.0	165
321	Vegetable soup with barley (157 gm.), cracker (7 gm.), roast pork (76 gm.), mashed potato (¼ cup), gravy, wax beans (39 gm.), bread (27 gm.), cottage pudding (48 gm.).	121	30.9	8.3	646	5.4	185
327	Beef broth with barley (110 gm.), cracker (6 gm.), chicken pie (190 gm.; chicken, potato, gravy, pastry), bread (21 gm.), tapioca pudding (47 gm.).	104	18.9	5.6	525	5.0	160
328	Beef broth with barley (122 gm.), cracker (6 gm.), roast beef, gravy, mashed potato (½ cup), string beans, bread (26 gm.), tapioca pudding (49 gm.).	92	20.6	6.0	456	5.0	145
329	Tomato soup (154 gm.), cracker (6 gm.), corned beef (45 gm.), potato (78 gm.), vegetables (198 gm.; cabbage, carrot, beet, turnip), bread (26 gm.), rice pudding with raisins (61 gm.).	131	24.4	6.8	624	4.8	180

* Not including butter and drink.
† Including butter and, in the case of restaurants A, B, C and D one glass of milk (see Table 16).
‡ "Savita sandwich" served with this dinner; not included in sample for analysis. Weighed 22 gm.; estimated energy content 90 cals.

TABLE 18 (*continued*). *Dinners*

No.	Description	Air-dry weight	Protein		Calories		
			Total in dinner*	For 10c†	Total in dinner*	Per gm. air-dry matter*	For 10c†
	Restaurant B (cont'd.)	gm.	gm.	gm.			
392	Pea soup (153 gm.), cracker (7 gm.), braised beef, vegetable gravy, mashed potato (¼ cup), string beans (¼ cup), bread, gingerbread with whipped cream (36 gm.).	148	38.9	10.0	722	4.9	200
393	Pea soup (148 gm.), cracker (5 gm.), roast lamb, mashed potato (¼ cup), gravy, peas (¼ cup), bread (27 gm.), gingerbread with whipped cream (30 gm.).	131	28.8	7.8	646	4.9	185
	Minimum	...	*18.9*	*5.6*	*456*	*4.4*	*145*
	Maximum	...	*43.1*	*11.0*	*795*	*5.7*	*220*
	AVERAGE	...	...	...	...	**5.0**	...
	Restaurant C						
471	Tomato soup (123 gm.), roast beef, gravy, mashed potato (88 gm.), spinach (¼ cup), bread (42 gm.), cornstarch pudding (90 gm.).	142	35.9	9.4	718	5.1	200
472	Tomato soup (123 gm.), roast fresh ham, gravy, mashed potato (98 gm.), apple sauce (63 gm.), bread (45 gm.), cornstarch pudding (101 gm.).	164	30.4	8.2	738	4.5	205
	Restaurant D						
277	Barley broth, roast beef, mashed potato, gravy, string beans, bread (3 slices), Indian pudding.	153	35.7	9.3	646	4.2	190
288	Pea soup (171 gm.), saltines (9 gm.), roast veal (69 gm.), gravy (9 gm.), mashed potato (78 gm.), peas (41 gm.), bread (54 gm.), bread pudding (95 gm.).	173	36.4	9.5	805	4.6	225
289	Pea soup (½ cup), saltines (2), smothered beef in onions (½ cup), mashed potato (1/3 cup), peas (¼ cup), bread (46 gm.), bread pudding.	164	34.9	10.3	773	4.7	245
292	Fish chowder, roast beef, mashed potato, stewed corn, bread, saltines, grapenuts pudding.	148	39.7	10.2	701	4.7	200

	Restaurant N						
349	Cream of celery soup with rice (358 gm.), roast pork, mashed potato (¼ cup), gravy, string beans, bread (68 gm.), pudding (221 gm.)	237	42.3	...	1200	5.1	...
353	Fish chowder (313 gm.), boiled halibut (88 gm.), browned potatoes (58 gm.), string beans (40 gm.), bread (59 gm.), pudding (124 gm.)	197	48.0	...	877	4.5	...
	Restaurant R						
352	Fish chowder (a cream soup, no fish or potato), crackers, baked haddock, Spanish sauce, pickled beets, boiled potatoes, bread, floating island pudding.	239	54.6	...	1060	4.5	...
	Restaurant Z						
357‡	V (1-5) celery (2 stalks, 33 gm.) v (19-112) vegetable soup (⅝ cup, 149 gm.) V (29-346) vegetable stew (1 1/3 cups, 338 gm.) corn bread (74 gm.) cold slaw (⅜ cup, 90 gm.) v (17-120) rice pudding (1/3 cup, 89 gm.)	145	15.7	...	668	4.6	...
358‡	V (1-5) celery (2 stalks, 29 gm.) v (19-112) vegetable soup (152 gm.) v (16-250) sauerkraut (1 cup; small boiled potato, Savita gravy (237 gm.) v (8-350) apple pie (139 gm.); cheese (10 gm.)	126	9.3	...	564	4.5	...
359	v (48-250) Boston baked beans (1 cup, 204 gm.) (25-300) 2 home-made rolls (65 gm.) v (3-173) baked apple (209 gm.); butter (9 gm.)	173	20.4	...	734	4.2	...
360	v (83-400) chicken croquette (½ cup), mashed potato with white sauce (½ cup)—total 230 gm. (21-150) bread (54 gm.) v (2-200) apple sauce (½ cup, 160 gm.) butter (9 gm.).	173	16.7	...	800	4.6	...
361	v (70-500) hot chicken toast sandwich, gravy, stuffing, mashed turnip; total 224 gm.	74	13.2	...	401	5.4	...
	AVERAGE ALL DINNERS	...	..	...	...	4.7	...

* Not including butter and drink.
† Including butter and, in the case of restaurants A, B, C, and D one glass of milk (see Table 16).
‡ "Savita sandwich" served with this dinner; not included in sample for analysis. Weighed 22 gm.; estimated energy content 90 cals.

TABLE 19. *Suppers.*

No.	Description	Cost	Air-dry weight	Protein		Calories		
				Total in supper*	For 10c†	Total in supper*	Per gm. air-dry matter*	For 10c†
	Restaurant A‡							
		cents	gm.	gm.	gm.			
122	Vegetable soup (1 cup), chop suey, browned potato, bread, roll, apple pie, cheese.	40	199	31.3	9.4	935	4.7	290
129	Broth, (2/3 cup), roast beef, browned potato, bread (61 gm.), chocolate cake.	40	170	38.4	11.2	703	4.1	230
131	Cream soup (⅞ cup), crackers (16 gm.), fruit salad (no mayonnaise), baked potato, bread (36 gm.), chocolate pudding with whipped cream.	40	260	19.8	6.5	1070	4.1	325
133	Cream soup (2/3 cup), crackers, baked beans, fried potatoes, bread (58 gm.), melon.	40	173	20.4	6.7	705	4.1	235
151	Soup, crackers, frankfurts (2), potato salad (marinated with French dressing), bread (34 gm.), frosted cake.	40	181	22.5	7.2	888	4.9	280
155	Soup, shrimp wiggle on toast, bread (35 gm.), chocolate pudding with whipped cream.	40	127	23.0	7.3	579	4.6	200
156	Soup, macaroni and tomato, bread (49 gm.), melon.	40	89	13.3	4.9	334	3.8	140
177	Pea soup (¾ cup), crackers, creamed chipped beef, browned potato, bread, chocolate ice cream.	40	176	27.6	8.5	762	4.3	245
188	Cream soup, ham, baked potato, bread, roll, honey-dew melon.	40	166	30.0	9.1	767	4.6	250
189	Cream soup, French toast, baked potato, bread, roll, loganberries.	40	264	24.8	7.8	1180	4.5	350
193	Broth, crackers, creamed chipped beef, fried potatoes, bread, pineapple custard.	40	205	26.0	8.1	970	4.7	300
194	Broth, crackers, American chop suey, fried sweet potatoes, bread, apple pie.	40	195	15.6	5.5	890	4.6	280
443	Vegetable soup (½ cup), crackers (16 gm.), fruit salad (221 gm.; mixed canned fruits, whipped cream, lettuce), creamed potato (126 gm.), bread (48 gm.), fudge cake (108 gm.).	40	233	18.3	6.2	1090	4.7	330
444	Cream soup (½ cup), crackers (17 gm.), salad (190 gm.; tuna fish, pineapple tidbits, pickle, lettuce), baked potato (160 gm.), whole wheat bread (58 gm.), apple pie (119 gm.), cheese (10 gm.).	40	231	36.1	10.6	1100	4.8	330

445	Cream soup (½ cup), crackers (17 gm.), creamed crabmeat on toast (148 gm.), baked potato (108 gm.), whole wheat bread (61 gm.), canned grapefruit (106 gm.).	40	169	24.4	7.7	824	4.9	265
449	Bouillon (2/3 cup), crackers (2), asparagus on toast, baked potato, bread, cranberry pie.	40	201	21.3	6.9	896	4.5	280
453	Chicken broth with rice (½ cup), crackers (14 gm.), chicken croquettes, white sauce, peas, baked potatoes (137 gm.), graham bread, white bread, loganberry shortcake with whipped cream (128 gm.).	40	254	35.4	10.4	1150	4.5	345
454	Chicken broth with rice (½ cup), crackers (15 gm.), fruit salad (241 gm.; banana, pineapple, lettuce, whipped cream), baked potatoes (114 gm.), graham bread (59 gm.), vanilla ice cream (116 gm.).	40	222	18.6	6.2	995	4.5	305
461	Tomato bisque (⅝ cup), crackers (15 gm.), sardine salad (90 gm., sardines, lettuce, mayonnaise), creamed potato (111 gm.), bread (47 gm.), whipped cream cake (107 gm.).	40	204	28.9	8.8	1090	5.3	330
462	Tomato bisque (⅝ cup), crackers (15 gm.), minced ham on toast (105 gm.), creamed potato (151 gm.), bread (49 gm.), canned cherries (55 gm.), cake (45 gm.).	40	213	33.8	10.0	1040	4.9	315
465	Bouillon (½ cup), crackers (2), French toast and brown sugar syrup, escalloped potatoes* (137 gm.), bread, whipped cream sandwich (2 cookies, whipped cream, cherry).	40	275	28.6	8.7	1350	4.9	395
466	Bouillon (½ cup), crackers, crabmeat salad (182 gm.; salmon, crabmeat, celery, lettuce, mayonnaise), escalloped potato (137 gm.), bread, lemon meringue pie (123 gm.).	40	209	39.5	11.4	970	4.6	300
	Minimum	..	...	*13.3*	*4.9*	*334*	*3.8*	*145*
	Maximum	..	...	*39.5*	*11.4*	*1350*	*5.3*	*395*
	AVERAGE	..	...	...	...	....	4.6	...
	Restaurant B‡							
271	Hot roast beef sandwich (2 slices bread, slice beef), French fried potatoes, gravy.	35	99	19.4	7.3	504	5.1	180
272	American chop suey (chopped beef, spaghetti, tomato, 2/3 cup), French fried potatoes, rolls (92 gm.).	40	149	22.7	7.3	668	4.5	215
273	Meat hash (2/3 cup), sweet pickles, rolls (93 gm.)	35	139	26.6	9.4	685	4.9	250
306	Hot chicken sandwich (2 slices bread, gravy, chicken, stuffing; 150 gm.), French fried potatoes (66 gm.), rolls (83 gm.).	40	153	27.6	8.5	670	4.4	215
308	Meat hash (1 cup, 168 gm.), sweet pickles, rolls (94 gm.).	35	145	28.2	9.9	732	5.1	265
311	Asparagus tips on toast with white sauce (169 gm.), French fried potatoes (85 gm.).	35	85	11.1	4.9	390	4.6	150

* Not including butter and drink.

† Including butter and glass of milk, when drink was served with meal (see Table 16).

‡ Choice of tea, coffee, or milk given with suppers at restaurants A, B (except No. 401), and with the first four suppers at restaurant D; choice assumed to be milk. No drink served with suppers 274-296, incl., at restaurant D. Choice of tea or coffee only given at restaurants N and R; because of uncertainty in amount of cream used, values on 10-cent basis not computed for these suppers.

TABLE 19 (*continued*). *Suppers.*

No.	Description	Cost	Air-dry weight	Protein		Calories		
				Total in supper*	For 10c†	Total in supper*	Per gm. air-dry matter*	For 10c†
	Restaurant B (cont'd.)							
312	Spanish meat pie (143 gm., meat, tomato, onion, gravy, pastry), French fried potatoes, (92 gm.), rolls (95 gm.).	cents 40	gm. 167	gm. 29.7	gm. 9.0	781	4.7	240
313	Sausage (97 gm.), mashed potato, gravy, rolls (92 gm.)...	35	157	24.6	8.8	850	5.4	295
381	Minced ham and scrambled egg (¾ cup, 101 gm.), French fried potatoes (111 gm.), rolls (82 gm.).	40	152	26.7	8.3	774	5.1	240
394	Cold roast pork (58 gm.), apple sauce (41 gm.), French fried potatoes (71 gm.), rolls (80 gm.).	40	151	23.4	7.4	763	5.0	240
399	Fried clams (113 gm.), French fried potatoes (71 gm.), rolls (83 gm.).	40	173	23.7	7.5	886	5.1	270
400	Shrimp wiggle on toast (196 gm., shrimps, peas, white sauce, 2 slices buttered toast), French fried potatoes (64 gm.).	40	103	21.1	6.8	483	4.7	155
401	Fish chowder (1½ cup, 320 gm., milk, potato, fish), crackers (16 gm.).	20	59	16.0	8.0	274	4.6	140
419	Meat hash (1 cup, 133 gm.), sweet pickles, rolls (81 gm.).	35	127	23.8	8.6	623	4.9	230
420	Asparagus on toast with white sauce (180 gm.), French fried potatoes (77 gm.).	30	95	11.1	5.8	426	4.5	185
	Minimum	..	...	*11.1*	*4.9*	*274*	*4.4*	*140*
	Maximum	..	...	*29.7*	*9.9*	*886*	*5.4*	*295*
	AVERAGE	...	...	...	...	....	**4.8**	...
	Restaurant C							
473	Meat hash (1 cup, 153 gm.), poached egg (45 gm.), sweet pickles, rolls (72 gm.).	30	167	39.1	13.1	898	5.4	320
474	Fricasseed lamb (1 cup), peas (¼ cup), mashed potato (86 gm.), rolls (71 gm.).	35	165	40.9	11.7	830	5.0	255
475	Broiled hamburg steak, gravy, mashed potato, (½ cup), sweet pickles, rolls (68 gm.).	35	154	35.3	10.1	763	4.9	235
	Restaurant D							
278‡	Hamburg steak (114 gm.), fried potatoes (69 gm.), rolls (89 gm.), apple pie (183 gm.).	45	256	46.8	11.8	1280	5.0	330
283‡	Baked beans (218 gm.), rolls (85 gm.), mince pie (137 gm.).	35	237	24.5	8.8	1140	4.8	385
286‡	Meat hash (146 gm.), fried egg (34 gm.), rolls (86 gm.), strawberry pie (128 gm.).	40	228	40.5	11.7	1200	5.3	350

294‡	Meat hash (140 gm.), fried egg (43 gm.), rolls (84 gm.), pineapple pie (148 gm.).	40	192	28.2	8.6	1020	5.3	305
274	Cold ham, potato salad with mayonnaise (1 cup), rolls (77 gm.).	35	145	31.2	8.9	757	5.2	240
275	Frankfurts (2), baked beans (½ cup), rolls (91 gm.).	30	163	32.0	10.7	826	5.1	300
276	Hot meat sandwich (slice roast beef, 2 slices bread, gravy), pan fried potatoes (¾ cup).	25	104	18.0	7.2	522	5.0	210
279	Fish cakes (117 gm.), fried egg, rolls (85 gm.).	30	128	31.7	10.6	648	5.1	240
280	Asparagus on toast (10 stalks asparagus, 3 slices well buttered toast).	35	51	7.0	2.0	243	4.8	70
282	Plain omelet (83 gm.), fried potatoes (94 gm.), rolls (78 gm.).	35	124	21.5	6.2	646	5.2	205
285	Fricasseed lamb (121 gm.), fried potatoes (98 gm.), rolls (86 gm.).	30	142	29.1	9.7	722	5.1	265
290	Ham omelet (118 gm.), fried potatoes (97 gm.), rolls (79 gm.).	35	151	32.5	9.3	778	5.2	245
291	Hamburg steak (89 gm.), fried potatoes (107 gm.), rolls (76 gm.).	35	151	35.5	10.2	720	4.8	225
295	Salmon salad (156 gm., with mayonnaise, celery, lettuce), fried potatoes (87 gm.), rolls (85 gm.).	35	138	31.2	8.9	760	5.5	240
296	Frankfurts (73 gm.), fried potatoes (117 gm.), rolls (89 gm.).	30	138	23.3	7.8	686	5.0	255
	Minimum	..	...	*7.0*	*2.0*	*243*	*4.8*	*70*
	Maximum	..	...	*46.8*	*11.8*	*1280*	*5.5*	*385*
	AVERAGE	..	...	...	...	....	**5.1**	...
	Restaurant N‡							
350	Pineapple and cream cheese salad (194 gm.; with lettuce, mayonnaise, whipped cream, walnut meats), bread (76 gm.), apple pie (124 gm.).	45	225	15.1	..	1270	5.7	...
	Restaurant R‡							
325	Consomme, cracker, ham omelet, Lyonnaise potatoes, wax beans, bread.	55	133	34.9	...	755	5.7	...
326	Consomme, cracker, plain chop suey, Lyonnaise potatoes, wax beans, bread.	50	137	20.5	..	611	4.5	...
339	Chicken broth, crackers, cold roast pork (132 gm.), apple sauce, peas, Scotch fried potatoes, bread (3 slices).	50	196	45.1	..	1070	5.4	...
	AVERAGE ALL SUPPERS	..	...	...	..	....	4.8	...

* Not including butter and drink.
† Including butter and glass of milk, when drink was served with meal (see Table 16).
‡ Choice of tea, coffee, or milk given with suppers at restaurants A, B (except No. 401), and with the first four suppers at restaurant D; choice assumed to be milk. No drink served with suppers 274-296, incl., at restaurant D. Choice of tea or coffee only given at restaurants N and R; because of uncertainty in amount of cream used, values on 10-cent basis not computed for these suppers.

been included in the estimations of the protein and the calories for ten cents. In those instances when a drink was included in the supper, we have assumed in our calculations that it was a glass of milk.

The total energy content varies more widely in these suppers than in the dinners. The range in protein content is also wide. The energy per gram of air-dry matter is again in most instances within 4.5 and 5.2 calories, with one low value of 3.8 calories and two high values of 5.7. On the average the value is 4.8 calories.

TOTAL FOOD EATEN IN ONE DAY BY ONE PERSON

On two different occasions a composite sample representative of the entire food consumption for one day was collected. The first sample, No. 254, included both the butter and the milk served with the meals. The second sample, No. 284, did not include them, but the calculation of the total energy and the total protein intake for the day takes these items into account. A description of the meals follows.

NO. 254

Breakfast (25 cents): Stewed prunes (4), scrambled eggs, corn meal muffins (2 served, 1 eaten), butter (½ of serving eaten), glass of milk. Restaurant A.

Dinner (45 cents): Fish chowder, boiled mackerel and mashed potato, stewed tomatoes, bread (1½ slices), butter, grapenut pudding, glass of milk. Restaurant B.

Supper (35 cents): Pineapple and cream cheese salad (2 leaves lettuce, 2 slices pineapple, cream cheese, and whipped cream), 2 rolls, butter. Restaurant B.

NO. 284

Breakfast (20 cents): One orange, oatmeal and milk (1 cup), 1 tsp. sugar (eaten on oatmeal but not in sample). Restaurant D.

Dinner (45 cents): Vegetable soup, fricasseed lamb, mashed potato, string beans, bread (3 slices served, 2 eaten), 2 saltines, butter (ca. 10 gm. eaten but not included in sample), small scoop vanilla ice cream. Restaurant D.

Supper (45 cents): Banana salad (1 cup sliced banana, ca. ½ tbsp. mayonnaise, lettuce), rolls (2 served, only one eaten), butter (ca. 8 gm. eaten but not included in sample), fudge cake (103 gm.). Restaurant D.

Butter (18 gm.), milk (½ pint), and 1 tsp. sugar eaten but not included in sample.

The results of the analyses of these two daily food samples are given in Table 20. The factor for calories per gram of air-dry matter is essentially the same in both instances, averaging 5.0. In sample 284 had the fat of the butter been included, the factor would doubtless have been somewhat higher, possibly 5.1 or 5.2.

TABLE 20. *Total Protein and Energy Intake of an Individual During One Day.*

No.	Cost	Total air-dry weight	Protein		Calories		
			Total for day	For 10 cents	Total for day	Per gram air-dry matter	For 10 cents
		gm.	gm.	gm.			
254	$1.05	415	73.4	7.0	2050	4.9	195
284	$1.10	360*	49.6†	4.5†	2140†	5.0*	195†

* Not including butter milk, and sugar for cereal.
† Including butter, milk, and sugar for cereal.

The Department of Home Economics at the University of New Hampshire conducts a so-called "Practice House" where meals are prepared by and served to women students. Analyses were made of the meals served here on seven different days, and the details are given in Table 21. In this particular study the samples included the butter, and the milk or cream and sugar for the drink served with the meals, since varying amounts of these items were served on different days. The tea or coffee itself was not included in the sample. The charge to the student for these meals was based only upon the cost of the food supplies, the operating expenses being paid by the Department of Home Economics. Hence no economic consideration of these data can be given.

The total calories in the day's food consumption varied astonishingly from 1680 on November 1 to 3090 on November 3. The average energy intake was 2446 calories and the average protein intake 61 grams per day. The calories per gram of air-dry matter averaged 5.0, in good agreement with the average values found with the free selection of meals listed in Tables 18 to 20. Although the values for the separate samples listed in Table 21 range from 4.5 to 5.5, in no case does the average value for the day (including breakfast, lunch, and dinner) differ greatly from 5.0. This suggests that a close relationship exists between the total energy content and the air-dry

TABLE 21. *Protein and Energy Content in Total Daily Meals.*

No.	Meal	Air-dry weight	Protein in meal	Calories	
				In meal	Per gram air-dry matter
	October 31	gm.	gm.		
239	*Breakfast and lunch*: Sliced bananas, cream, post toasties, milk, sugar, toasted whole wheat bread, butter, jelly, cocoa with marshmallow. ..... Chicken soup, with macaroni, 3 buttered saltines, apple roly-poly, lemon sauce, glass of milk.	256	34.5	1250	4.9
240	*Dinner*: Salad (tuna fish, pineapple, cream cheese, olives, lettuce), graham bread, butter, chocolate waffle with whipped cream, top milk and sugar for tea. ..	222	28.4	1230	5.5
	TOTAL FOR DAY—	...	63	2480	..
	November 1				
241	*Breakfast and lunch*: Orange, bacon, graham muffin, butter, top milk and sugar for coffee. ..... Cream of celery soup, 3 buttered saltines, banana and nut tapioca pudding with cream, cookie, glass of milk.	195	22.6	1010	5.2
243	*Dinner*: Vegetable plate (boiled potato, beets, turnip, carrot, cabbage), graham bread, butter, lemon sauce pudding, cream and sugar for tea.	149	10.9	670	4.5
	TOTAL FOR DAY—	...	34	1680	..
	November 2				
244	*Breakfast and lunch*: Stewed apricots, malt breakfast food, milk, sugar, doughnut, cocoa with marshmallow. ..... Vegetable hash, pickle, graham bread, butter, sponge cake with boiled frosting, glass of milk.	283	30.7	1310	4.6
245	*Dinner*: Ham omelet with cabbage and celery relish, small white and small sweet potatoes, rolls, butter, squash pie, creamed cauliflower, sugar for lemonade.	218	33.4	1100	5.0
	TOTAL FOR DAY—	...	64	2410	..
	November 3				
246	*Breakfast and lunch*: Shredded wheat biscuit, top milk and sugar, grapes, bran muffins, butter, jelly, cream and sugar for coffee. ..... Cheese sauce and bacon on two slices of toast, salad (tomato, lettuce, mayonnaise), brambles, glass of milk.	326	32.6	1630	5.0

247	*Dinner*: Roast pork, baked apple, spinach, stuffed baked potato, rolls, butter, fruit gelatine with whipped cream, cookie, cream and sugar for tea.	278	36.8	1460	5.2
	TOTAL FOR DAY—	...	70	3090	..
	November 4				
248	*Breakfast and lunch*: Stewed apricots, oatmeal, top milk, sugar, doughnut, cream and sugar for coffee. ..... Creamed codfish and hard boiled egg on toast, lettuce with mayonnaise, floating island pudding, nabisco, cream and sugar for tea.	201	23.7	990	4.9
249	*Dinner*: Salmon, mashed potato, cream sauce, peas, celery, apple pie, cheese, roll, butter.	225	35.4	1140	5.1
	TOTAL FOR DAY—	...	59	2130	..
	November 8				
250	*Breakfast and lunch*: Orange, oatmeal, milk, sugar, bran muffin, butter, cream and sugar for coffee. ..... Cream of corn soup, saltines, butter, cherry jello with whipped cream, vanilla cookies, cream and sugar for tea.	222	23.9	1110	5.0
251	*Dinner*: Roast beef, gravy, sweet potato, creamed corn, carrots, cabbage, celery relish, graham bread, butter, chocolate frosted cake, glass of milk.	272	36.8	1380	5.1
	TOTAL FOR DAY—	...	61	2490	..
	November 9				
252	*Breakfast and lunch*: Post toasties and bran, milk, sugar, toasted graham bread, butter, jelly, grapes, cocoa with marshmallow. ..... Hash, pickles, rolls, butter, peach shortcake with whipped cream, glass of milk.	401	51.8	2040	5.1
253	*Dinner*: Boiled dinner (roast beef, boiled potato, beets, cabbage, turnip, carrots), graham bread, butter, coffee tapioca with cream, vanilla wafers.	165	24.7	800	4.8
	TOTAL FOR DAY—	...	77	2840	..
	Minimum				*4.5*
	Maximum				*5.5*
	AVERAGE				5.0

matter in these mixed meals and that if one knows the air-dry weight of the mixed foods for one day, one week, or for any desired period of time, one can multiply this by the factor 5 and have a close estimate of the total energy intake.

GENERAL DISCUSSION

Innumerable analyses of the energy value of various foods have already been made. The tables of Atwater and Bryant,[1] first published in 1896, have been of incalculable service in computing the total energy intake in the food eaten daily, and are today the basis of most of the tables of energy values of foods printed in the best modern textbooks on dietetics and nutrition.[2] Many of these early analyses have dealt with cooked foods, but in the course of years the methods of cooking have changed and many combinations of previously prepared foods are now on the market. It is, therefore, difficult oftentimes to calculate the caloric intake in the modern diet from the Atwater-Bryant tables. The elaborate study of ready-to-serve foods carried out by Gephart and Lusk[3] in the Childs restaurants has helped considerably, so far as the servings from this particular chain of restaurants are concerned. And yet our own data show that even in these restaurants the methods of cooking and the preparation of the servings are not sufficiently standardized to enable one to compute with accuracy the energy intake from the calories claimed to be in the different portions served. The Battle Creek Sanitarium, emphasizing the signifiance of vegetables, likewise prints on its menu cards the calories in the food served. But the food at Childs restaurants and at the Battle Creek Sanitarium is not necessarily representative of the food served in other restaurants or in one's home. Hence we must use the old Atwater-Bryant tables, which are in many ways inadequate for computing the energy content of the modern diet.

One of the three factors determining the true energy value of a food is the amount of energy in the food leaving the body undigested in the excreta. With humans this loss of energy is small, and the actual heat of combustion of human food can be accepted as indicative of its true energy value. But with cattle a large proportion of the food eaten leaves the alimentary tract undigested. Hence the heat of combustion of cattle food cannot be considered indicative of its real energy value, but the heat of combustion of the feces must also be determined. The development of the oxy-calorimeter at the Nutri-

(1) Atwater, W. O., and C. D. Woods, U. S. Dept. Agric., Office Expt. Sta., Bulletin No. 28, 1896; revised editions published in 1902 and 1906 by Atwater, W. O., and A. P. Bryant.

(2) See, for example, Rose, M. S., Feeding the family, New York, 1925; Laboratory handbook for dietetics, New York, 1929; The foundations of nutrition, New York, 1927.

(3) Gephart, F. C., and G. Lusk, Analysis and cost of ready-to-serve foods, Chicago, 1915.

tion Laboratory and its extensive practical use in our research at the New Hampshire Agricultural Experiment Station demonstrate that it is now possible to determine the energy value both of the modern diet and of feces accurately and in much less time than is required in the use of the complicated bomb calorimeter.

The technique of the oxy-calorimeter requires two simple procedures, the drying of the sample of food or feces to an air-dry condition and the burning of the air-dry sample in the apparatus. The latter procedure requires only 15 minutes at most, and experience in the burning of samples can be readily acquired. An individual whose energy intake is to be studied can easily cooperate with the clinician or dietitian in securing the air-dry sample of his food by placing in a previously weighed pan a duplicate of each serving of food eaten during the day. At the end of the day the pan will contain a duplicate of the total food intake. If extreme accuracy is required, the weight of the food eaten should be known and an equivalent weight placed in the pan. But if a serving of food seemingly similar to the serving eaten is placed in the dish, the error involved is for most purposes insignificant. In a large dietary study of twelve men voluntarily undergoing a period of undernutrition,[1] duplicate samples of the food served to the twelve men were placed in two extra dishes on the table, termed the "thirteenth and the fourteenth men." The agreement between these two samples was all that could be expected, and this method of sampling the day's food intake was considered satisfactory.

Examination of the data secured in our research with the oxy-calorimeter suggests that in the case of mixed meals, at least, the energy value may be estimated by an even simpler means than the use of the oxy-calorimeter. With the individual food items such as doughnuts, candy, ice cream, and the like, the ratio between the energy content and the weight of air-dry matter was often found to vary rather widely. But with the mixed meals the ratio was remarkably constant, 5 calories per gram of air-dry matter on the average. In view of the high digestibility of the foods consumed by man, it is clear that by determining the air-dry weight in grams of a mixture of foods and by multiplying this weight by the factor 5, one can estimate the total calories in a mixed meal with a relatively high degree of accuracy. This procedure does away with the necessity for using either the bomb or the oxy-calorimeter, and although it cannot have the scientific accuracy of either of these rigidly tested means of energy measurement, nevertheless we believe that as a procedure in the hospital and in the dietetic laboratory it is of great practical value.

In the tabular presentation of our data emphasis has been laid upon the calories and the protein which may be purchased for ten

(1) Benedict, F. G., W. R. Miles, P. Roth, and H. M. Smith, Carnegie Inst. Wash. Pub. No. 280, 1919, p. 68.

cents. Although economics is not one of the first considerations of the average individual, there are nevertheless in every college community many students who must work their way and obtain their education with a minimum expenditure of money. Any information which will enable them to make a more intelligent selection of food, be it only from the economic standpoint, is worthy of emphasis. The variability in the daily energy intake of an individual is determined in large part by his free choice of food. But when it is possible for a student earning his way through college to select a 40-cent meal at a cafeteria and secure therefrom only 334 calories (see Table 19, Sample 156), he should be aware of that fact.

If digestibility and practicability were left out of consideration, one could obtain the total number of calories required for the day in ten or twelve cents' worth of cane sugar. Obviously a diet exclusively of cane sugar is impracticable, because the vitamines, salts, and protein are absent and because the digestive tract of man cannot take care of this amount of sugar per day. The second objection could be removed by substituting potatoes or rice or some other inexpensive vegetable which will furnish the requisite number of calories at a low price. But these would not supply an adequate amount of protein. The wise selection of food is, therefore, not simply a question of calories. Some consideration must be given to the protein intake, to the digestibility of the food, and to a certain extent to the palatability of the food. The cafeterias and restaurants now offer such a wide variety of foods that it should be possible to make selections which are at the same time digestible, reasonably palatable, and economical. It is still a question whether the relatively inexpensive milk furnished in a college community is used widely enough. A quart of milk at 12 cents affords 33 grams of protein and 687 calories. One cannot of course exist exclusively upon milk, but milk should enter more generally into the diet than it apparently does, judging from the restaurant menus and our impressions of students' eating habits obtained during the progress of this research.

In emphasizing the important part which energy intake plays in nutrition, we would not have the student overlook the value of the vitamines, salts, and proteins; yet we believe that for a short period these could be safely disregarded. It is not necessary, for example, that the food intake *each day* should contain exactly the correct proportions of protein, vitamines, and salts. The adaptability of the human body is such that there may easily be large variations in the intake of vitamines and salts from day to day without the slightest harm to the body. The source of vitamines is frequently an expensive one. Those obtained in milk are ideal, and this is another quality of milk which makes it such a valuable food. On the other hand, when one relies for vitamines and salts upon leafy, green vegetables and fruits eaten out of season, the expense is considerable.

One striking observation made during our research was that the coarse breads and cereals are so seldom eaten. The experience of one of us during the World War when studying a group of men living on reduced rations,[1] showed that the liberal use of bran, and by this we do not refer to the expensive packages of bran but to ordinary bran, is a most fruitful source of salts, vitamines and roughage. It is not inconceivable that with suitable education, college communities may come to the "open bran bowl" at the table as well as the "open sugar bowl." On the other hand, a warning should be issued that some individuals react unfavorably to bran and that one should first test slowly the amount to be eaten rather than take excessive amounts without previous experience.

The eating of meals, even in a college community, is not a matter, however, simply of scientific stoking or gathering in of calories. Dining is supposedly a feature. But one can hardly be said to have dined, even in the best organized college cafeteria. Such cafeterias are run at minimum cost and are supposed to give the students the best meals possible for a minimum amount of money, with only moderate attention paid to luxury of service or "atmosphere." For this reason the college student perhaps cannot be too critical of flavor and environment. He should emphasize the food value obtained for the money paid and let flavor and atmosphere be a secondary consideration. Certainly the data given in this report show that it is possible for one to select meals varying greatly in energy and protein content, and it would seem justifiable in a college community, where courses in nutrition are offered as part of the educational program, to give the student at least an approximate idea of the value of the food he is purchasing by stating directly on the menu the average number of calories and the average grams of protein probably contained in the food served.

SUMMARY

A survey of the energy and the protein content of a large number of individual foods and of mixed meals has been made in the college community at Durham, New Hampshire, in a cooperative research undertaken by the New Hampshire Agricultural Experiment Station and the Nutrition Laboratory of the Carnegie Institution of Washington. The energy values were obtained with an oxy-calorimeter developed at the Nutrition Laboratory. The nitrogen analyses were carried out by the Kjeldahl method.

Studies were made of the meals served at the local restaurants and at the home economics practice house; a few samples were obtained in Dover, New Hampshire, and in Boston. The separate food items which were analyzed included breads, doughnuts, sandwiches, salads, pies, ice cream, and candies.

(1) Benedict, F. G., W. R. Miles, P. Roth, and H. M. Smith, Carnegie Inst. Wash. Pub. No. 280, 1919, p. 260.

Five-cent packages of sandwiches sold in waxed paper and consisting of crackers with various fillings were found to contain nearly 200 calories each, or as much energy as that in the average 10-cent fresh sandwich.

Fifteen-cent servings of ice cream averaged about 200 grams in weight, 500 calories of total energy and 7 grams of protein. The energy value per ten cents of sundaes from the drug stores was about 250 calories or nearly 100 calories less than in the ice cream. One pint of chocolate milk shake furnished from 450 to 500 calories and from 14 to 15 grams of protein.

Sixty-six candies were analyzed and the results averaged in nine groups according to their composition. Per gram of weight as purchased, the average caloric values ranged from 6.4 with the group of chocolate nut bars to 3.7 with the miscellaneous candies not chocolate coated and containing no nuts. On the average, one can obtain not far from 450 calories per ten cents in this form of food.

Thirty-four dinners from the college cafeteria furnished from 517 to 1610 calories and from 10 to 60 grams of protein each, not including the butter and beverage. Twenty-nine dinners from three commercial restaurants in Durham contained from 456 to 805 calories and from 19 to 43 grams of protein. Assuming that butter and a glass of milk were taken with these meals, the calories per ten cents ranged from 165 to 410 at the cafeteria and from 145 to 245 at the restaurants, and the protein content per ten cents varied from 4 to 15 grams and from 6 to 11 grams, respectively.

Twenty-two suppers selected at the cafeteria varied in energy and protein content per ten cents in much the same manner as the dinners. Food combinations served at the other restaurants at night yielded from 70 to 385 calories and from 2 to 13 grams of protein per ten cents (figures include glass of milk, if beverage was served, and butter).

The meals served each student at the home economics practice house for a week averaged 2450 calories and 61 grams of protein per day.

The data on mixed meals indicate that the energy value of the total food consumed per day, per week, or for any period of time may be estimated with a relatively high degree of accuracy by obtaining the air-dry weight of a food mixture and multiplying it by the factor 5. This procedure does away with the necessity for using either the bomb or the oxy-calorimeter and gives the physician and the dietitian a simple means of calculating the energy intake with a degree of accuracy sufficient for most purposes.

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